PLAGIARISM CHECK REPORTS BY URKUND

DEPARTMENT OF BUSINESS FINANCE & ECONOMICS
FACULTY OF COMMERCE & MANAGEMENT STUDIES
JAI NARAIN VYAS UNIVERSITY, JASWANT CAMPUS, JODHPUR

Dr. RAMAN KUMAR DAVE
PROFESSOR AND HEAD

Certificate of Ph.D. Course Work

This is to certify that ***Mr.Himalaya Siyota*** has qualified the Ph.D. Course-Work (JNVU-MPET 2015) in the Department of Business Finance and Economics organized by Jai Narain Vyas University, Jodhpur.

This Certificate is issued in accordance with the provisions of UGC (Minimum Standards and Procedure for Award of M.Phil/Ph.D. degree) Regulations 2009 notified in the Gazette of India on 11th July, 2009.

HEAD

Head
Department of Bus. Fin. &
Faculty of Commerce & Mgt.
J.N.V University, JODHPUR

DEAN

DEAN
Faculty of Commerce & Management Studies
Jai Narain Vyas University
JODHPUR (RAJ.)

Prof.(Dr.) RAMAN KUMAR DAVE
Professor and Head
Email-ramandave@rediffmail.com
Mobile- +91-98290-22338

Department of Business, Finance and Economics
Jai Narain Vyas University,
Jodhpur

Date:

CERTIFICATE OF PLAGIARISM CHECK

Name of Research Scholar	MR. HIMALAY SIYOTA
Course of Study	DOCTOR OF PHILOSOPHY
Name of Research Supervisor	PROFESSOR (DR.) RAMAN KUMAR DAVE
Title of the thesis	EXPLORING THE IMPACT OF DIGITAL TECHNOLOGY ON RETAIL BANKING CONSUMER IN RAJASTHAN
Department	Business Finance and Economics
Faculty	Faculty of Commerce and Management Studies
Acceptable Maximum Limit	10%
Percentage of Similarity of Content Identified	8%
Software Used	URKUND
Date of Verification	02 Dec, 2020 4:58:00 AM

URKUND analysis report is attached

URKUND

Document Information

Analyzed document	Final Thesis.docx (D87478191)
Submitted	12/2/2020 4:58:00 AM
Submitted by	Dr. Mangu Ram
Submitter email	bhatia.mram@gmail.com
Similarity	8%
Analysis address	bhatia.mram.jnvu@analysis.urkund.com

Himalay

Himalay Siyota
Research Scholar

9/12/202

Professor (Dr.) Raman Kumar Dave
Research Supervisor

DEPARTMENT OF BUSINESS FINANCE & ECONOMICS
FACULTY OF COMMERCE & MANAGEMENT STUDIES
JAI NARAIN VYAS UNIVERSITY, JODHPUR

PROFESSOR (DR.) RAMAN KUMAR DAVE
HEAD OF DEPARTMENT

No. JNVU/COMM/BFE/2020/ 529 **November 28, 2020**

CERTIFICATE

This is to certify that Mr.Himalay Siyota, Research Scholar in the Department supplicating for the degree of Ph.D. under the supervision of Prof.(Dr.)Raman Kumar Dave, has made Pre Ph.D. presentation before submission of Ph.D. Thesis in front of the following faculty members on her work entitled "*EXPLORING THE IMPACT OF DIGITAL TECHNOLOGY ON RETAIL BANKING CONSUMERS IN RAJASTHAN*" in the Chamber of Head, Department of B.F.E., Jai Narain Vyas University, Jodhpur on Saturday, the 28th November, 2020 at 12:30 PM.

Sr.No.	Name of Faculty	Signature
1	Dr. (Mrs) Navneeta Singh	N. Singh 28/11/2020
2	Dr. R. P. Meena	28/11/2020
3.	Dr. K. A. Goyal	K-A Goyal 28/11/2020
4.	Dr. Anju Agarwal	28/11/2020

The candidate gave presentation on the topic and set all the queries. It was unanimously decided by all those present to recommend the submission of the Thesis. On the basis of recorded recommendation of the faculty members, Mr.Himalay Siyota is allowed to submit Ph.D. Thesis as per University norms.

4.12.2020

(Dr.Raman Kumar Dave)
PROFESSOR AND HEAD
Head
Department of Business Finance & Economics
Faculty of Comm. & Mgt Studies
Jai Narain Vyas University
Jodhpur (Raj.) 342001

DEPARTMENT OF BUSINESS FINANCE & ECONOMICS
FACULTY OF COMMERCE & MANAGEMENT STUDIES
JAI NARAIN VYAS UNIVERSITY, JASWANT CAMPUS, JODHPUR

Dr. RAMAN KUMAR DAVE
PROFESSOR AND HEAD

Certificate of Ph.D. Course Work

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Faculty of Commerce & Mgt.
J.N.V University, JODHPUR

DEAN

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Faculty of Commerce & Management Studies
Jai Narain Vyas University
JODHPUR (RAJ.)

Prof.(Dr.) RAMAN KUMAR DAVE
Professor and Head
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Mobile- +91-98290-22338

Department of Business, Finance and Economics
Jai Narain Vyas University,
Jodhpur

Date:

CERTIFICATE OF PLAGIARISM CHECK

Name of Research Scholar	MR. HIMALAY SIYOTA
Course of Study	DOCTOR OF PHILOSOPHY
Name of Research Supervisor	PROFESSOR (DR.) RAMAN KUMAR DAVE
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URKUND

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Analyzed document	Final Thesis.docx (D87478191)
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Submitted by	Dr. Mangu Ram
Submitter email	bhatia.mram@gmail.com
Similarity	8%
Analysis address	bhatia.mram.jnvu@analysis.urkund.com

Himalay

Himalay Siyota
Research Scholar

9/12/202

Professor (Dr.) Raman Kumar Dave
Research Supervisor

DEPARTMENT OF BUSINESS FINANCE & ECONOMICS
FACULTY OF COMMERCE & MANAGEMENT STUDIES
JAI NARAIN VYAS UNIVERSITY, JODHPUR

PROFESSOR (DR.) RAMAN KUMAR DAVE
HEAD OF DEPARTMENT

No. JNVU/COMM/BFE/2020/ 529 **November 28, 2020**

CERTIFICATE

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4.	Dr. Anju Agarwal	28/11/2020

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4.12.2020

(Dr.Raman Kumar Dave)
PROFESSOR AND HEAD
Head
Department of Business Finance & Economics
Faculty of Comm. & Mgt Studies
Jai Narain Vyas University
Jodhpur (Raj.) 342001

Dr. Pawan K. Kasera
Professor & Head

DEPARTMENT OF BOTANY
J.N. VYAS UNIVERSITY
JODHPUR 342005 (Raj.)

CENTRE OF ADVANCED STUDY

CERTIFICATE

Certified that the present thesis entitled: "**Biology and chemical characterization of some tuberous medicinal plants**" is being submitted in full requirement for the Degree of Doctor of Philosophy to the Jai Narain Vyas University, Jodhpur. It is a record of original investigation carried out by (Ms.) Arti Soni, CSIR-NET SRF, who worked with me as a Research Scholar. This work has been carried out under my supervision and has not been submitted for any degree to any other University in India or abroad.

December 6, 2019

6.12.19

[Pawan K. Kasera]
Research Supervisor

Dr. Pawan K. Kasera
Professor
Department of Botany
J.N. Vyas University
JODHPUR-342 033 (Raj.)

Forwarded

6.12.19

PROFESSOR & HEAD
DEPARTMENT OF BOTANY
J. N. VYAS UNIVERSITY
JODHPUR 342005 (RAJ.)

Dr. Pawan K. Kasera
Professor & Head

DEPARTMENT OF BOTANY
J.N. VYAS UNIVERSITY
JODHPUR 342005 (Raj.)

CENTRE OF ADVANCED STUDY

PRE-Ph.D. THESIS SUBMISSION PRESENTATION

CERTIFICATE

This is to certify that **(Ms.) Arti Soni**, Ph.D. scholar (Registration No. JNVU/Aca/R/14/363) is working with Professor Pawan K. Kasera in the Department of Botany (UGC-CAS) on the topic entitled: **"BIOLOGY AND CHEMICAL CHARACTERIZATION OF SOME TUBEROUS MEDICINAL PLANTS"**. She has joined the Plant Ecology Laboratory on 05.02.2013 and registered on 22.01.2014 after completion of Ph.D. course work. She has satisfactorily completed the Pre-Ph.D. thesis submission presentation held on 19th October 2019, that is a part of the Ph.D. program.

20.10.19

[Pawan K. Kasera]

PROFESSOR & HEAD
DEPARTMENT OF BOTANY
J. N. VYAS UNIVERSITY
JODHPUR-342005 (RAJ.)

JAI NARAIN VYAS UNIVERSITY, JODHPUR

FACULTY OF SCIENCE

CERTIFICATE

Date : 02/01/2014 No. 120

This is to certify that Mr./Ms. Arti Soni

in the Department of Botany

Jai Narain Vyas University, Jodhpur has qualified the course work organized by the university during Session 2012 - 2013.

This Certificate is issued in accordance with the provisions of UGC (Minimum Standards and Procedure for Award of M.Phil/Ph.D. Degree) Regulations 2009 notified in the Gazette of India on 11th July 2009.

HEAD

DEAN

Head
Department of Botany
Jai Narain Vyas University
JODHPUR

DEAN
FACULTY OF SCIENCE
Jai Narain Vyas University
JODHPUR

DEPARTMENT OF BOTANY
CENTRE OF ADVANCED STUDY
J. N. V. UNIVERSITY, JODHPUR 342005 (Raj.)

CERTIFICATE OF PLAGIARISM CHECK

1.	Name of the Research Scholar	**(Ms.) ARTI SONI**
2.	Course of the study	**Ph.D. (Botany)**
3.	Title of the Thesis	**BIOLOGY AND CHEMICAL CHARACTERIZATION OF SOME TUBEROUS MEDICINAL PLANTS**
4.	Name of the Research Supervisor	**PROF. PAWAN K. KASERA**
5.	Department	DEPARTMENT OF BOTANY, CENTRE OF ADVANCED STUDY J. N. V. UNIVERSITY, JODHPUR (RAJASTHAN)
6.	Acceptable Maximum Limit	10%
7.	Percentage of Similarity of content identified	2%
8.	Software used	URKUND
9.	Date of verification	25.11.2019

URKUND Analysis result report is attached

Date: November 29th, 2019

आरती सोनी

Signature of the Candidate

6.12.19

Signature of the Supervisor

Dr. Pawan K. Kasera
Professor
Department of Botany
J. N. Vyas University
JODHPUR-342 033 (Raj.)

URKUND

Urkund Analysis Result

Analysed Document:	**Arti Thesis .pdf (D59571926)**
Submitted:	**11/25/2019 12:58:00 PM**
Submitted By:	**pkkasera1963@gmail.com**
Significance:	**2 %**

Sources included in the report:

Introduction Anuradha 14.11.2019.pdf (D58915288)
Jyoti Sharma Phd Thesis Env SC.docx (D30075232)
Eco-Physiological_studies_on_Perilla_frutescens(L)_Britton_in_Garhwal_Himalayas_Uttarakhand_by_Swanti.docx (D40840274)
MAin thesis Sujit-Check (1).pdf (D39840932)
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https://businessdocbox.com/Forestry/78710537-Site-characteristics-and-regeneration-studies-of-bani-oak-quercus-glauca-thunberg-in-himachal-pradesh-thesis-amare-tesfaye-f-d.html
https://www.ajol.info/index.php/ajest/article/download/74209/64861

Instances where selected sources appear:

16

DECLARATION

The work compiled in present thesis entitled **"BIOLOGY AND CHEMICAL CHRACTERIZATION OF SOME TUBEROUS MEDICINAL PLANTS"** is submitted for the degree of Doctor of Philosophy to Jai Narain Vyas University, Jodhpur. The research described herein was conducted under the supervision of **Professor Pawan K. Kasera,** Department of Botany, Centre of Advanced Study, Jai Narain Vyas University, Jodhpur since January 2014 to till date.

To the best of my knowledge this work is original, except where acknowledgement and references are made to the previous work. The work has not been submitted so far, in part or in full, for award of any other degree, diploma or other qualification in this or any other University.

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(Arti Soni)
Research Scholar

Dr. Pawan K. Kasera
Professor & Head

DEPARTMENT OF BOTANY
J.N. VYAS UNIVERSITY
JODHPUR 342005 (Raj.)

CENTRE OF ADVANCED STUDY

CERTIFICATE

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December 6, 2019

6.12.19

[Pawan K. Kasera]
Research Supervisor

Dr. Pawan K. Kasera
Professor
Department of Botany
J.N. Vyas University
JODHPUR-342 033 (Raj.)

Forwarded

6.12.19

PROFESSOR & HEAD
DEPARTMENT OF BOTANY
J. N. VYAS UNIVERSITY
JODHPUR 342005 (RAJ.)

Dr. Pawan K. Kasera
Professor & Head

DEPARTMENT OF BOTANY
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20.10.19

[Pawan K. Kasera]

PROFESSOR & HEAD
DEPARTMENT OF BOTANY
J. N. VYAS UNIVERSITY
JODHPUR-342005 (RAJ.)

JAI NARAIN VYAS UNIVERSITY, JODHPUR

FACULTY OF SCIENCE

CERTIFICATE

Date : 02/01/2014 No. 120

This is to certify that Mr./Ms. Arti Soni

in the Department of Botany

Jai Narain Vyas University, Jodhpur has qualified the course work organized by the university during Session 2012 - 2013.

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HEAD

DEAN

Head
Department of Botany
Jai Narain Vyas University
JODHPUR

DEAN
FACULTY OF SCIENCE
Jai Narain Vyas University
JODHPUR

DEPARTMENT OF BOTANY
CENTRE OF ADVANCED STUDY
J. N. V. UNIVERSITY, JODHPUR 342005 (Raj.)

CERTIFICATE OF PLAGIARISM CHECK

1.	Name of the Research Scholar	**(Ms.) ARTI SONI**
2.	Course of the study	**Ph.D. (Botany)**
3.	Title of the Thesis	**BIOLOGY AND CHEMICAL CHARACTERIZATION OF SOME TUBEROUS MEDICINAL PLANTS**
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Date: November 29th, 2019

आरती सोनी

Signature of the Candidate

6.12.19

Signature of the Supervisor

Dr. Pawan K. Kasera
Professor
Department of Botany
J. N. Vyas University
JODHPUR-342 033 (Raj.)

URKUND

Urkund Analysis Result

Analysed Document:	**Arti Thesis .pdf (D59571926)**
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MAin thesis Sujit-Check (1).pdf (D39840932)
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https://businessdocbox.com/Forestry/78710537-Site-characteristics-and-regeneration-studies-of-bani-oak-quercus-glauca-thunberg-in-himachal-pradesh-thesis-amare-tesfaye-f-d.html
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(Arti Soni)
Research Scholar

JAI NARAIN VYAS UNIVERSITY
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Dr. K.R. GENWA
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094143-27569(M)
0291-2720840(O)
E-mail-krg2004@rediffmail.com

11th August,2021

CERTIFICATE OF PLAGIARISM CHECK

1.	Name of Research Scholar	CHANCHAL MAHAVAR
2.	Course of Study	DOCTOR OF PHILOSOPHY
3.	Title of the thesis	STUDY ON STABILITY AND PHOTOVOLTAIC PERFORMANCE OF SOME NEW DYES AND ELECTROLYTES FOR DYE SENSITIZED SOLAR CELLS
3.	Name of Supervisor	DR. K. R. GENWA
4.	Department	CHEMISTRY
5.	Acceptable Maximum Limit	10%
6.	Percentage of Similarity of Content Identified	2%
7.	Software used	URKUND
8.	Date of Verification	09-08-2021

Curigional

Document Information

Analyzed document	thesis_chanchalmahavar (for plagiarism)1.pdf (D111115603)
Submitted	8/9/2021 7:48:00 PM
Submitted by	K R Genwa
Submitter email	krgenwa@gmail.com
Similarity	2%
Analysis address	krgenwa.jnvu@analysis.urkund.com

Sources included in the report

W	URL: https://docplayer.net/58773006-Dye-sensitized-solar-cell-optimizing-materials-methods-and-optoelectronic-effects.html Fetched: 2/4/2020 10:16:53 AM	2
W	URL: https://en.wikipedia.org/wiki/Plasmonic_solar_cell#cite_ref-6 Fetched: 8/9/2021 7:49:00 PM	4
W	URL: https://en.wikipedia.org/wiki/Dye-sensitized_solar_cell Fetched: 8/9/2021 7:49:00 PM	7

Research Scholar

(Prof. K. R. GENWA)
Research Supervisor
Professor
Department of Chemistry
J.N.V.University, Jodhpur

Jai Narain Vyas University
Jodhpur (India)

Dr. K. R. GENWA
Professor
Department of Chemistry
Jai Narain Vyas University
Jodhpur (Raj.)-342005, India

Phone: 02912731001(R)
02912720840(O)
9414327569(M)
E-mail: krg2004@rediffmail.com

18 July,2019

CERTIFICATE

I feel great pleasure in certifying that the thesis entitled "STUDY ON STABILITY AND PHOTOVOLTAIC PERFORMANCE OF SOME NEW DYES AND ELECTROLYTES FOR DYE SENSITIZED SOLAR CELLS" embodies a record of the results of the investigation carried out by Ms. Chanchal Mahavar, (M.Sc Chemistry) Ph. D. Research Scholar, Department of Chemistry, under my supervision and guidance.

It is an original piece of work and to the best of my knowledge, it has not been submitted anywhere else in part or full in India or abroad for the award of Ph. D. degree.

I recommend the submission of the thesis.

(Prof. K. R. GENWA)
Research Supervisor

Forwarded:

Prof. & Head
Department of Chemistry
J.N.V. University, Jodhpur

Head of Department

DECLARATION BY THE CANDIDATE

I declare that the thesis entitled "STUDY ON STABILITY AND PHOTOVOLTAIC PERFORMANCE OF SOME NEW DYES AND ELECTROLYTES FOR DYE SENSITIZED SOLAR CELLS", Submitted by me for the degree of Doctor of Philosophy is the record of work carried out by me during the period from 2015 to 2019 under the guidance of Dr. K. R. Genwa (Professor, Department of Chemistry, Jai Narain Vyas University, Jodhpur).

I further declare that, to the best of our knowledge, the current thesis does not infringe upon anyone's copyright nor violate any proprietary rights and that any ideas, techniques, quotations or any other materials from the work of other people included in our thesis, published or otherwise, are fully acknowledged in accordance with the standard referencing practices. I have checked write up of the present thesis using anti-plagiarism database and it is in allowable limit. Even though later on in case of any complaint pertaining of plagiarism, I am solely responsible for the same.

Date: 19th July 2019

Place: JODHPUR

Signature of Research Scholar

(Miss. Chanchal Mahavar)

JAI NARAIN VYAS UNIVERSITY, JODHPUR

(DEPTT. OF CHEMISTRY)

CERTIFICATE

Date : 23.07.2015 No. 72

This is to certify that Mr./Ms. Chandal Mahavar in the Department of Chemistry, Jai Narain Vyas University, Jodhpur has qualified the course work organized by the university during Session 2014-2015.

This Certificate is issued in accordance with the provisions of UGC (Minimum Standards and Procedure for Award of M.Phil/Ph.D. Degree) Regulations 2009 notified in the Gazette of India on 11th July 2009.

P.K. Sharma

Prof. & Head
Department of Chemistry
J.N.V. University,
Jodhpur.

HEAD

DEAN

Dean
Faculty of Science
J.N.V. University

JAI NARAIN VYAS UNIVERSITY
JODHPUR (INDIA)

Dr. K.R. GENWA
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Department of Chemistry
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2.	Course of Study	DOCTOR OF PHILOSOPHY
3.	Title of the thesis	STUDY ON STABILITY AND PHOTOVOLTAIC PERFORMANCE OF SOME NEW DYES AND ELECTROLYTES FOR DYE SENSITIZED SOLAR CELLS
3.	Name of Supervisor	DR. K. R. GENWA
4.	Department	CHEMISTRY
5.	Acceptable Maximum Limit	10%
6.	Percentage of Similarity of Content Identified	2%
7.	Software used	URKUND
8.	Date of Verification	09-08-2021

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Research Scholar

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Research Supervisor
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18 July,2019

CERTIFICATE

I feel great pleasure in certifying that the thesis entitled "STUDY ON STABILITY AND PHOTOVOLTAIC PERFORMANCE OF SOME NEW DYES AND ELECTROLYTES FOR DYE SENSITIZED SOLAR CELLS" embodies a record of the results of the investigation carried out by Ms. Chanchal Mahavar, (M.Sc Chemistry) Ph. D. Research Scholar, Department of Chemistry, under my supervision and guidance.

It is an original piece of work and to the best of my knowledge, it has not been submitted anywhere else in part or full in India or abroad for the award of Ph. D. degree.

I recommend the submission of the thesis.

(Prof. K. R. GENWA)
Research Supervisor

Forwarded:

Prof. & Head
Department of Chemistry
J.N.V. University, Jodhpur

Head of Department

DECLARATION BY THE CANDIDATE

I declare that the thesis entitled "STUDY ON STABILITY AND PHOTOVOLTAIC PERFORMANCE OF SOME NEW DYES AND ELECTROLYTES FOR DYE SENSITIZED SOLAR CELLS", Submitted by me for the degree of Doctor of Philosophy is the record of work carried out by me during the period from 2015 to 2019 under the guidance of Dr. K. R. Genwa (Professor, Department of Chemistry, Jai Narain Vyas University, Jodhpur).

I further declare that, to the best of our knowledge, the current thesis does not infringe upon anyone's copyright nor violate any proprietary rights and that any ideas, techniques, quotations or any other materials from the work of other people included in our thesis, published or otherwise, are fully acknowledged in accordance with the standard referencing practices. I have checked write up of the present thesis using anti-plagiarism database and it is in allowable limit. Even though later on in case of any complaint pertaining of plagiarism, I am solely responsible for the same.

Date: 19th July 2019

Place: JODHPUR

Signature of Research Scholar

(Miss. Chanchal Mahavar)

JAI NARAIN VYAS UNIVERSITY, JODHPUR

(DEPTT. OF CHEMISTRY)

CERTIFICATE

Date : 23.07.2015 No. 72

This is to certify that Mr./Ms. Chandal Mahavar in the Department of Chemistry, Jai Narain Vyas University, Jodhpur has qualified the course work organized by the university during Session 2014-2015.

This Certificate is issued in accordance with the provisions of UGC (Minimum Standards and Procedure for Award of M.Phil/Ph.D. Degree) Regulations 2009 notified in the Gazette of India on 11th July 2009.

P.K. Sharma

Prof. & Head
Department of Chemistry
J.N.V. University,
Jodhpur.

HEAD

DEAN

Dean
Faculty of Science
J.N.V. University

JAI NARAIN VYAS UNIVERSITY, JODHPUR
(DEPARTMENT OF GEOGRAPHY)

CERTIFICATE

This is to certify that **Ms. Priyanka Bisht** in the Department of **Geography**, Jai Narain Vyas University, Jodhpur has qualified the Course-Work organized by the university in the year 2013-14.

This Certificate is issued in accordance with the provisions of UGC (Minimum standards and procedure for award of M.Phil/Ph.D. degree) Regulations 2009 notified in the gazette of India on 11th July, 2009.

HEAD
Deptt.of Geography
Prof. & Head
Department of Geography
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DEAN
Faculty of Arts,Education
&Social Sciences
DEAN
Faculty of Arts, Edu.& Social Sciences
Jai Narain Vyas University
JODHPUR

JAI NARAIN VYAS UNIVERSITY, JODHPUR
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No. JNVU/Aca/R/15/ Date:

The Head
Department **Geography**
Jai Narain Vyas University
Jodhpur.

Sir/Madam,

With reference to your endorsement on the application of **Mr./Ms. Priyanka Bisht** for registration as Research Scholar to supplicate for the Degree of **Ph.D.**/D.Sc./ D.Litt./LL.D. in the Department of **Geography** of this University, I am to inform you that his/her name has been registered as such and he/she has been permitted to conduct research on the subject **AN ANALYTICAL STUDY OF POTABLE WATER QUALITY IN JAIPUR DISTRICT, RAJASTHAN (A CASE STUDY OF BASSI AND CHAKSU TEHSILS)** the Supervision of **Dr. A.L. Meena** with effect from **03.09.2014**

Yours truly,

ASSTT. REGISTRAR

No. JNVU/Aca/R/15/ 3040 Date: 29-1-2015

Copy forwarded to:

1. The Dean, Faculty of **Arts.**
2. **Dr. A.L. Meena ,** Res. Sup. Deptt. of **Geography,** JNVU, Jodhpur
3. **Mr./ Ms. Priyanka B isht ,** E-107, Rameshwar Nagar, Ajmer
4. The Assistant Registrar, Faculty of **Arts.**
5. The Assistant Registrar, Development Section, JNVU, Jodhpur
6. The Assistant Registrar, Examination Section, JNVU, Jodhpur.

ASSTT. REGISTRAR

JAI NARAIN VYAS UNIVERSITY, JODHPUR
DEPARTMENT OF GEOGRAPHY

No. JNVU/ GEOG./R/19/2533 **Date: 19.12.2019**

CERTIFICATE

This is certified that Ms. Priyanka Bisht has given Pre Ph.D. Presentation on 19.12.2019. at 1:15 p.m. on her Ph.D. title **" AN ANALYTICAL STUDY OF POTABLE WATER QUALITY IN JAIPUR DISTRICT, RAJASTHAN (A CASE STUDY OF BASSI AND CHAKSU TEHSILS)"** in the Department of Geography, Language Wing, New Campus. She has done Ph.D. work under the supervision of Dr. Arjun Lal Meena and her presentation was satisfactory.

19-12-2019

Head
Department of Geography

DR. ARJUN LAL MEENA
Assistant Professor

Department of Geography,
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Jodhpur (Raj.) 342011

NO.JNVU/GEO/R/2020/ 2638

Date:06.03.2020

RESIDENTIAL CERTIFICATE

It is certified that Ms. Priyanka Bisht, Research Scholar, Department of Geography worked under my supervision w.e.f. 03/09/2014 to 06/03/2020 for her Ph.D. work. She resided in the municipal limit of Jodhpur for more than two years during the above mentioned period as per university ordinance 211.

Date:06.03.2020

Place : Jodhpur

Forwarded
6/3/2020
Prof. & Head
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Dr. Arjun Lal Meena
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Assistant Professor
Department of Geography
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Dr. Arjun Lal Meena
M.A., M.Phil., Ph.D., SLET, NET
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Practical Exam, Faculty of Arts,
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Department of Geography
Jai Narain Vyas University,
Jodhpur- 342011

Date: 28.02.2020

CERTIFICATE

This is to certify that the present thesis entitled as "**AN ANALYTICAL STUDY OF POTABLE WATER QUALITY IN JAIPUR DISTRICT, RAJASTHAN (A CASE STUDY OF BASSI AND CHAKSU TEHSILS)**" is hereby submitted as requirement for the degree of doctor of Philosophy to Jai Narain Vyas University, Jodhpur, Rajasthan (India). It is an original piece of work carried by Ms. **Priyanka Bisht**, Research Scholar, Department of Geography, Jai Narain Vyas University, Jodhpur under my supervision. This work or any part of this work has not been submitted elsewhere for award any degree in India or abroad in my knowledge.

Supervisor
(Dr. Arjun Lal Meena)

Supervisor
Department of Geography
Jai Narain Vyas University

JAI NARAIN VYAS UNIVERSITY, JODHPUR
(DEPARTMENT OF GEOGRAPHY)

No. JNVU/Geog./20/2637

Date: 06.03.2020

Ph.D. Submission Certificate

To Whoever It May Concern

This is to certify that **Ms. Priyanka Bisht** has submitted her Ph.D. Thesis on 06.03.2020 on the title **"AN ANALYTICAL STUDY OF POTABLE WATER QUALITY IN JAIPUR DISTRICT, RAJASTHAN (A CASE STUDY OF BASSI AND CHAKSU TEHSILS)"** Registration no. JNVU/Aca/R/15/3040 under the supervision of Dr. Arjun Lal Meena, Assistant Professor, Department of Geography, Jai Narain Vyas Universitry, Jodhpur.

6/3/2020

(Dr. Jai Singh)
Prof. & Head

Prof. & Head
Department of Geography
J.N. Vyas University, Jodhpur (Raj.)

DR. ARJUN LAL MEENA
(M.A., M.Phil., Ph.D., SLET, NET-JRF, CSIR-UGC SPM)
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Department of Geography,
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Jodhpur (Raj.) – 342011

Date: 24-02-2020

CERTIFICATE OF PLAGIARISM CHECK

Name of Research Scholar	Ms. Priyanka Bisht
Course of Study	Doctor of Philosophy (Ph.D.)
Title of Thesis	AN ANALYTICAL STUDY OF POTABLE WATER QUALITY IN JAIPUR DISTRICT, RAJASTHAN (A CASE STUDY OF BASSI AND CHAKSU TEHSILS)
Name of Supervisor	Dr. Arjun Lal Meena
Department	Geography
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Percentage of similarity of content identified	03%
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Priyanka Bisht

Research Scholar
(Priyanka Bisht)

Supervisor/ Asst. Professor
(Dr. Arjun Lal Meena)

Supervisor
Department of Geography
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Jodhpur

JAI NARAIN VYAS UNIVERSITY, JODHPUR
(DEPARTMENT OF GEOGRAPHY)

CERTIFICATE

This is to certify that **Ms. Priyanka Bisht** in the Department of **Geography**, Jai Narain Vyas University, Jodhpur has qualified the Course-Work organized by the university in the year 2013-14.

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HEAD
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Faculty of Arts,Education
&Social Sciences
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JAI NARAIN VYAS UNIVERSITY, JODHPUR
(ACADEMIC SECTION)

No. JNVU/Aca/R/15/ Date:

The Head
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Jodhpur.

Sir/Madam,

With reference to your endorsement on the application of **Mr./Ms. Priyanka Bisht** for registration as Research Scholar to supplicate for the Degree of **Ph.D.**/D.Sc./ D.Litt./LL.D. in the Department of **Geography** of this University, I am to inform you that his/her name has been registered as such and he/she has been permitted to conduct research on the subject **AN ANALYTICAL STUDY OF POTABLE WATER QUALITY IN JAIPUR DISTRICT, RAJASTHAN (A CASE STUDY OF BASSI AND CHAKSU TEHSILS)** the Supervision of **Dr. A.L. Meena** with effect from **03.09.2014**

Yours truly,

ASSTT. REGISTRAR

No. JNVU/Aca/R/15/ 3040 Date: 29-1-2015

Copy forwarded to:

1. The Dean, Faculty of **Arts.**
2. **Dr. A.L. Meena ,** Res. Sup. Deptt. of **Geography,** JNVU, Jodhpur
3. **Mr./ Ms. Priyanka B isht ,** E-107, Rameshwar Nagar, Ajmer
4. The Assistant Registrar, Faculty of **Arts.**
5. The Assistant Registrar, Development Section, JNVU, Jodhpur
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ASSTT. REGISTRAR

JAI NARAIN VYAS UNIVERSITY, JODHPUR
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No. JNVU/ GEOG./R/19/2533 **Date: 19.12.2019**

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19-12-2019

Head
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NO.JNVU/GEO/R/2020/ 2638

Date:06.03.2020

RESIDENTIAL CERTIFICATE

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Date:06.03.2020

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Department of Geography
Jai Narain Vyas University,
Jodhpur- 342011

Date: 28.02.2020

CERTIFICATE

This is to certify that the present thesis entitled as "**AN ANALYTICAL STUDY OF POTABLE WATER QUALITY IN JAIPUR DISTRICT, RAJASTHAN (A CASE STUDY OF BASSI AND CHAKSU TEHSILS)**" is hereby submitted as requirement for the degree of doctor of Philosophy to Jai Narain Vyas University, Jodhpur, Rajasthan (India). It is an original piece of work carried by Ms. **Priyanka Bisht**, Research Scholar, Department of Geography, Jai Narain Vyas University, Jodhpur under my supervision. This work or any part of this work has not been submitted elsewhere for award any degree in India or abroad in my knowledge.

Supervisor
(Dr. Arjun Lal Meena)

Supervisor
Department of Geography
Jai Narain Vyas University

JAI NARAIN VYAS UNIVERSITY, JODHPUR
(DEPARTMENT OF GEOGRAPHY)

No. JNVU/Geog./20/2637

Date: 06.03.2020

Ph.D. Submission Certificate

To Whoever It May Concern

This is to certify that **Ms. Priyanka Bisht** has submitted her Ph.D. Thesis on 06.03.2020 on the title **"AN ANALYTICAL STUDY OF POTABLE WATER QUALITY IN JAIPUR DISTRICT, RAJASTHAN (A CASE STUDY OF BASSI AND CHAKSU TEHSILS)"** Registration no. JNVU/Aca/R/15/3040 under the supervision of Dr. Arjun Lal Meena, Assistant Professor, Department of Geography, Jai Narain Vyas Universitry, Jodhpur.

6/3/2020

(Dr. Jai Singh)
Prof. & Head

Prof. & Head
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(M.A., M.Phil., Ph.D., SLET, NET-JRF, CSIR-UGC SPM)
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Jodhpur (Raj.) – 342011

Date: 24-02-2020

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Name of Research Scholar	Ms. Priyanka Bisht
Course of Study	Doctor of Philosophy (Ph.D.)
Title of Thesis	AN ANALYTICAL STUDY OF POTABLE WATER QUALITY IN JAIPUR DISTRICT, RAJASTHAN (A CASE STUDY OF BASSI AND CHAKSU TEHSILS)
Name of Supervisor	Dr. Arjun Lal Meena
Department	Geography
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Date of Verification	24 February 2020, 2:27 PM

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Priyanka Bisht

Research Scholar
(Priyanka Bisht)

Supervisor/ Asst. Professor
(Dr. Arjun Lal Meena)

Supervisor
Department of Geography
Jai Narain Vyas University
Jodhpur

Dr. S.R. Jakhar
Professor & Head

DEPARTMENT OF GEOLOGY
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Date: 30./09/2020

Place: Jodhpur

(Prof. S.R. Jakhar)
Research Supervisor

Professor
Department of Geology
Faculty of Science (New Campus)
Jai Narain Vyas University
Jodhpur - 342 001 (Raj.)

Bhuraram rojh

JAI NARAIN VYAS UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF GEOLOGY

Jodhpur, Rajasthan -342005

Dr. S.R. Jakhar, Professor & Head Mob: 9413208900 Email:srjakhar@yahoo.com

Date 07.08.2020

CERTIFICATE

This is to certify that Research Scholar Mr. Bhura Ram Rojh gave his pre-Ph. D. thesis submission open presentation in the Department on 07.08.2020 on the his Ph.D. work done by him on the topic entitled "A Study of Aquifers Characteristics, Groundwater Resources and Qualities of Groundwater from part of Marwar Basin and Palana-Ganganagar Shelf of Nagaur District, Rajasthan" under supervision of Prof. S.R. Jakhar. It is found that the research work is satisfactory and suitable for the Ph.D degree. Therefore, he may submit the final thesis to the office of the Research Board, Jai Narain Vyas University, Jodhpur.

Bhuraram Rojh

Research Supervisor

(Prof. S.R. Jakhar)

Head of the Department

Professor & Head
Department of Geology
Faculty of Science
J. N. Vyas University
JODHPUR

Dr. S.R. Jakhar
Professor & Head

DEPARTMENT OF GEOLOGY
FACULTY OF SCIENCE
JAI NARAIN VYAS UNIVERSITY
JODHPUR – 342005

CERTIFICATE

This is to certify that the thesis entitled **"A Study of Aquifers Characteristics, Groundwater Resources and Qualities of Groundwater from part of Marwar Basin and Palana- Ganganagar Shelf of Nagaur District, Rajasthan"** submitted for the award of the Degree of Doctor of Philosophy in Geology, Faculty of Science, Jai Narain Vyas University, Jodhpur, is a record of original investigations carried out by **Mr. Bhura Ram Rojh** who worked under my supervision since18.08.2015.

It is further certified that to the best of my knowledge no such work has so far been submitted for a degree in any other university in India or Abroad.

He has completed the following requirements as per UGC regulations 2009 for the award of Ph.D. degree of the Jai Narain Vyas University, Jodhpur;

a) Admission by entrance test JNVU–MPET - 2014 and qualified the Pre-Ph.D. course work in year 2015 as per the university ordinance [(O.201(i)]
b) Residential requirements as per the university ordinance (O.211)
c) Regularly submitted six monthly progress reports (O.212)
d) Presented the draft of Ph.D. thesis work in the Department on 07.08.2020, prior to submission of the Ph.D. thesis [O.214–A(i)]
e) Published a research papers in the referred research journals/UGC-CARE list journal [O.214–A(ii)]

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(Prof. S. R. Jakhar)
Research Supervisor

Professor
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Faculty of Science (New Campus)
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Jodhpur - 342 001 (Raj.)

Bhuraram Rojh

JAI NARAIN VYAS UNIVERSITY, JODHPUR

FACULTY OF SCIENCE

CERTIFICATE

Date : 18-8-2015 No. 311

This is to certify that Mr./~~Ms.~~ BHURA RAM ROJH in the Department of GEOLOGY. Jai Narain Vyas University, Jodhpur has qualified the course work organized by the university during Session 2014-15.

This Certificate is issued in accordance with the provisions of UGC (Minimum Standards and Procedure for Award of M.Phil/Ph.D. Degree) Regulations 2009 notified in the Gazette of India on 11th July 2009.

Professor & Head
Department of Geology
Faculty of Science
J.N. Vyas University
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HEAD

Dean
Faculty of Science
J.N.V. University
JODHPUR.

DEAN

Bhurarom Rojh

(Dr. S.R. Tiwari)
Research Supervisor

Professor & Head
Department of Geology
Faculty of Science
J. N. Vyas University
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Dr. S.R. Jakhar
Professor & Head

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Mob. : 9413208900
E-mail: srjakhar@yahoo.com

RESIDENCE CERTIFICATE

This is to certify that **Mr. Bhura Ram Rojh** who is registered Research Scholar under my supervision and has fulfilled the requirement of Article O.211 of Ph.D. ordinance and has stayed in the municipal area of Jodhpur city for over two years after Ph.D. registration i.e. from 18.08.2015.

Date: 30./09/2020
Place: Jodhpur

(Prof. S. R. Jakhar)
Research Supervisor
Professor
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Faculty of Science (Main Campus)
Jai Narain Vyas University
Jodhpur - 342 001 (Raj.)

Bhuraram Rojh

Dr. S.R. Jakhar
Professor & Head

DEPARTMENT OF GEOLOGY
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Mob. : 9413208900
E-mail: srjakhar@yahoo.com

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Date: 30./09/2020

Place: Jodhpur

(Prof. S.R. Jakhar)
Research Supervisor

Professor
Department of Geology
Faculty of Science (New Campus)
Jai Narain Vyas University
Jodhpur - 342 001 (Raj.)

Bhuraram rojh

JAI NARAIN VYAS UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF GEOLOGY

Jodhpur, Rajasthan -342005

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Bhuraram Rojh

Research Supervisor

(Prof. S.R. Jakhar)

Head of the Department

Professor & Head
Department of Geology
Faculty of Science
J. N. Vyas University
JODHPUR

Dr. S.R. Jakhar
Professor & Head

DEPARTMENT OF GEOLOGY
FACULTY OF SCIENCE
JAI NARAIN VYAS UNIVERSITY
JODHPUR – 342005

CERTIFICATE

This is to certify that the thesis entitled **"A Study of Aquifers Characteristics, Groundwater Resources and Qualities of Groundwater from part of Marwar Basin and Palana- Ganganagar Shelf of Nagaur District, Rajasthan"** submitted for the award of the Degree of Doctor of Philosophy in Geology, Faculty of Science, Jai Narain Vyas University, Jodhpur, is a record of original investigations carried out by **Mr. Bhura Ram Rojh** who worked under my supervision since18.08.2015.

It is further certified that to the best of my knowledge no such work has so far been submitted for a degree in any other university in India or Abroad.

He has completed the following requirements as per UGC regulations 2009 for the award of Ph.D. degree of the Jai Narain Vyas University, Jodhpur;

a) Admission by entrance test JNVU–MPET - 2014 and qualified the Pre-Ph.D. course work in year 2015 as per the university ordinance [(O.201(i)]
b) Residential requirements as per the university ordinance (O.211)
c) Regularly submitted six monthly progress reports (O.212)
d) Presented the draft of Ph.D. thesis work in the Department on 07.08.2020, prior to submission of the Ph.D. thesis [O.214–A(i)]
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Date : 18-8-2015 No. 311

This is to certify that Mr./~~Ms.~~ BHURA RAM ROJH in the Department of GEOLOGY. Jai Narain Vyas University, Jodhpur has qualified the course work organized by the university during Session 2014-15.

This Certificate is issued in accordance with the provisions of UGC (Minimum Standards and Procedure for Award of M.Phil/Ph.D. Degree) Regulations 2009 notified in the Gazette of India on 11th July 2009.

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RESIDENCE CERTIFICATE

This is to certify that **Mr. Bhura Ram Rojh** who is registered Research Scholar under my supervision and has fulfilled the requirement of Article O.211 of Ph.D. ordinance and has stayed in the municipal area of Jodhpur city for over two years after Ph.D. registration i.e. from 18.08.2015.

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Title Of Thesis	ESTIMATION OF GLYCEMIC INDEX OF LOCAL FOODS CONSUMED BY DIABETIC PATIENTS OF JODHPUR CITY AND ITS IMPACT ON THEIR BLOOD GLUCOSE LEVEL
Name of Supervisior	Dr. Raka Srivastava
Department	Home Science
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Chapter-1 Introduction

13 I Chapter – 1 INTRODUCTION n

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the management of diabetes mellitus, diet has been recognized as a cornerstone of the therapy. There is a considerable evidence to show that good control of blood glucose prevents or delay the debilitating complications of diabetes. The use of carbohydrate both in terms of quantity as well as quality in diabetes meal planning has always been a key therapeutic issue. The amount of total carbohydrate recommended for diabetic diet has varied significantly over the years.

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There are many traditional beliefs regarding the type of carbohydrate in the diabetic diet, which in

the

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recent years are questioned. According to traditional thoughts, simple sugars are rapidly digested and absorbed and therefore

people suffering from diabetes mellitus should restrict the amount and preparations containing simple sugars.` Blood glucose levels are raised after food containing carbohydrates (sugars and starch) are eaten. Different rank of carbohydrate counting also affects the blood glucose levels differently. GLYCEMIC INDEX:- The glycemic index (GI) is a relative ranking of carbohydrate in foods according to how they affect the blood glucose levels. Carbohydrates with low GI value are more slowly digested, absorbed and metabolized and cause a lower and slower rise

14 in blood glucose and therefore affects the need and action of insulin uptake by the body. The concept of glycemic index (GI) was proposed by Jenkins and colleagues in 1981 to characterize the rate of carbohydrate absorption after a meal (Jenkins et al. 1981).

GI

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is defined as the area under the glucose response curve after consumption of 50 g carbohydrate from a test food

divided by the area under the curve after consumption of 50 g carbohydrate from a control food, either white bread or glucose (Wolever et al. 1991). Over the past two decades, the GI of most commonly consumed carbohydrate-containing foods has been measured (Foster- Powell and Miller 1995).

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Many factors together, including carbohydrate type, fiber, protein, fat, food form and method of preparation, determine the GI of a particular food (

Bjorck et al. 1994, Estrich et al. 1967, Welch et al. 1987, Wolever et al. 1991). Professor David J.A. Jenkins who is a British born university professor in the department of nutritional sciences at the University of Toronto, Canadain the year 1981 is credited with developing the concept of glycemic index as a way of explaining the way in which dietary carbohydrate impacts the blood sugar. His first paper on subject appeared in the American Journal of Clinical Nutrition in 1981.

According to Jenkins, Diabetes mellitus has various types: Type 1, Type 2, Gestational diabetes mellitus and others such as Maturity onset diabetes in the young (MODY), Latent autoimmune diabetes of adulthood (LADA), What all these disorders have in common is an inherent inability to self- regulate the levels of blood glucose or cellular fuel in the body. Type 2 diabetes, the most common type of diabetes, is also one of the most prevalent chronic disease around. Worldwide, more than 150 million people suffer from the disease; the international diabetes federation projects that this population will double globally by the year 2025, while excess body weight is a major risk

15 factor for type 2 diabetes, ethnic background, family history and certain components of your health profile also play an important role. Type 2 diabetes is not caused by absence of hormone insulin, as in case with type 1 diabetes but it is rather caused by body's inability to use insulin properly. People with type 2 diabetes have a condition called insulin resistance. They can produce insulin, usually in sufficient amount at first ,but it doesn't bind properly to the insulin receptor that is the gateway to cell in muscle, fat, liver tissue and therefore, resistant to its effects. As a result, glucose doesn't enter the cells and instead . The second condition that sets the stage for type 2 diabetes is insulin deficiency- the pancreas also has difficulty producing sufficient amount of insulin to process the rising blood glucose levels. Eventually, it does not have sufficient amounts to overcome the deficit. The toxic effects of long term high glucose levels on the insulin producing beta cells on the pancreas (glucotoxicity) can make insulin deficiency worse. Type 2 diabetes does not strike without warning. Pre-diabetes, also known as impaired glucose tolerance (IGT) or impaired fasting glucose(IFG) precedes the condition by months, years and sometimes by decades. As the name suggests, pre-diabetes is defined by blood glucose levels that are higher than normal but not as high enough to indicate diabetes. The actual clinical criteria for diagnosis of pre diabetes is blood glucose level of 110 to 125 mg/dL as determine by fasting blood glucose test and post prandial (2 hours after meal) rising is to 140- 199mg/dL.(ADA) Pre diabetes is a signal that if lifestyle changes and correction in eating pattern is not done, you are most likely to on the path of full-fledged type 2 diabetes. And having pre-diabetes is a danger in itself. It increases the chances of stroke and heart disease by 50% and may also be associated with an increased risk of colon cancer.

16 According to ADA (American Diabetes Association) one of the reason for the boom in type 2 diabetes is the widening of waistbands and the trend towards a more sedentary lifestyle in developed and developing countries .Increasing cases of obesity and wrong eating habits ,more interest of consuming packed and processed food are also contributing in worsening the condition by 40% and obesity and newly diagnosed cases are increasing rapidly. The progression of type 2 diabetes is associated with risk factors which are : Age and ethinicity:- According to American Diabetes Association, over half of all cases in people over age fifty five and older suffer from type 2 diabetes. Therefore, Individuals over the age of forty five should be tested for diabetes and retested every three years thereafter if the initial test is normal. Family history:- Heridity plays a very important role in development of type 2 diabetes. If you have first degree relative (strong genetic/family) history, chances of developing the disease and its risk doubles. Hypertension and cholesterol levels: Hypertension or blood pressure higher than 140/90 mmHg, is both a possible complication of type 2 diabetes and a risk factor for the development of disease. A large scale of over 12,000 patients published in the New Journal Of Medicine in the year 2000 found that people with diagnosed hypertension were 2.5% most likely to develop type 2 diabetes than those with normal blood pressure and the study also shows the correlation between the beta blockers(a medication used to treat high blood pressure) and an increased risk of type 2 diabetes. Triglyceride

17 levels over 250mg/dL and levels of HDL or (good cholesterol) under 35 mg/dL put you on the risk of type 2 diabetes. Risk associated with weight and BMI:- The ADA suggested that obesity has been on steady rise over the past few decades, with nearly one- third of all adults over the age group of twenty are classified as obese, according to the 1999-2000 National Health And Nutrition Examination Survey (NHANES) Being overweight or obese is a primary risk factor for developing pre diabetes and type 2 diabetes. The U.S Department of Health And Human Services (HHS) reports that over 80% of people with type 2 diabetes are clinically obese. Too much fat makes it difficult for the body to use its own insulin to process blood glucose and bring it to down to normal circulating levels. BMI stands for body mass index- a number to express weight in relationship to height and it is a reliable indicator of overall body fat. People with BMI of 25 to 29.9 are considered overweight. Further obesity is classified on the basis of BMI grading. Extreme obesity is classified as BMI 40 or above 40. The NIDDK (National Institute Of Diabetes And Digestive And Kidney Disease) reports that 67 % of people with type 2 diabetes have a BMI of 27 and above and 46% have a BMI of 30 or higher. BMI range between 18.5 to 24.9 is considered to be normal. The four main reasons are :- 1. Overweight people have fewer available insulin receptors 2. More fat requires more insulin 3. Excess fat promotes further insulin resistance. 4. Fat cells release free fatty acids (FFAs)

18 As discovered by Rockefeller university researcher in 1995, leptin (a hormone in fat cells that helps to metabolize fatty acids) also plays an important role in sending a satiety or full signal to brain to stop eating when body fat increases and an empty signal when body fat is insufficient. The United Nations FAO/WHO has suggested the consumption of healthy diet

as a management and prevention strategy for these diseases and recommends the use of glycaemic index (GI) of food along with information related to food composition so that people can make better food choices (FAO/WHO, 1998, 2015). Foods with high GI are not only responsible for insulin related complications and high lipid concentrations but are also evidenced to be a risk factor for obesity (Schwingshackl and Hoffmann, 2013), depression in women (Gangwisch et al., 2015) and metabolic syndrome which is characterized by abdominal obesity, hyperlipidemia, hypercholesterolemia, hypertension and high fasting blood glucose levels (Song et al., 2014) The criteria of selecting the topic is very significant as diabetes mellitus gets directly affected by quantity and quality of carbohydrate consumed. Diet plays a very significant role in managing diabetes and therefore, ADA (American Diabetes Association)refers to dietary management of diabetes as “MEDICAL NUTRITION THERAPY” (MNT).The food we eat has direct impact on our blood glucose levels and therefore also on diabetes control and its related riskand complications. All about Carbohydrates:- The body began to convert carbohydrate almost entirely into glucose shortly after carb containing foods are eaten. .If there is inadequate or insufficient insulin to help process this glucose into cellular fuel, consuming too many carbohydrate can cause blood glucose to rise to dangerous levels. Without carbohydrate generated glucose you could not function, yet too much can cause irreparable damage.

19 All foods that contain starches/ sugars- including fruits, vegetables, milk, breads, grains, beans, pasta. To avoid carbohydrate containing foods is both impossible and unadvisable- our body needs the important micro nutrient and phytochemicals present in these foods, In fact, WHO recommends that carbohydrate from a variety of foods account for 55 % of total calories in our daily diet. Does it matter what kind of carbohydrate we consume? At one time nutritionist believed that people with diabetes should avoid simple sugars (mono and disaccharides) and eat food containing complex carbohydrate, instead with the mistaken belief that simple sugars would raise glucose levels faster and more dramatically. But now its known that gram for gram, complex carbohydrates found in bread, cereals, potatoes, vegetables, roots and tubers and other food raises the blood sugar approximately the same amount as simple sugar like honey, fructose or table sugar. However, there may be a difference in how rapidly certain foods raise sugar levels. The Glycemic index or GI is a measure of how quickly the carbs in certain foods are digested and transformed into blood glucose. When we talk about diet management in diabetes, the first and foremost thing comes to our mind is climatic conditions, locally grown foods according to type of soil, system and interest developed in eating practices from generations, belief systems, physical activity, eating frequency, type of food, eating habits, local availability ,income group and regional values and culture. As we know there is a trend of consumption of calorie rich diet in western belt of Rajasthan specifically jodhpur and the number of cases of diabetes are increasing rapidly, evaluation of glycemic index of local foods and most frequently consumed

20 foods on regular basis will act as a guideline to make correct food choices both in quality and quantity. The GI of foods does not necessarily correspond to specific carbohydrate “type” – some complex carbohydrate may have higher GI than simple carbohydrate. For people of jodhpur city diagnosed with type 2 diabetes and pre diabetes, the Glycemic index can be an effective tool for avoiding blood sugar spikes. Importance of counselling in management of diabetes: Atherapeutic diet plays an important role in the treatment of diabetes. The diet may be used alone or in combination with insulin or oral hypoglycemic drugs. The diet counselling includes following important parameters :- • Type of carbohydrate • Cooking methods • Portion size • Frequency of meals. • Local availability. • Likes dislikes • Use of fiber in decreasing the later effects of calorie rich food. • Distribution of carbohydrates in every meal. • Including fibre in diet • Combination meals • Stage of diabetes with reference to absence or presence of any other complication.

21 OBJECTIVES:- The study was conducted to determine four important components:- 1. To study the consumption pattern of local foods among the people of Jodhpur city diagnosed with type 2 diabetes mellitus. 2. To list out most commonly consumed local foods by the selected subjects of Jodhpur city. 3. To estimate the Glycemic index of frequently consumed food items. 4. To provide suggestive guideline for making correct choices and portion control in meals to have better diabetes management. (Educational workshop by lecture method)

Chapter-3 METHODOLOGY

56 Chapter – 3 METHODOLOGY he present study was conducted to estimate the glycemic index of local foods consumed by diabetic patients of jodhpur city and its impact on their blood glucose level. Details of the methodology followed for the study have been described below: Locale The study was conducted in Jodhpur city of Rajasthan.. The samples were obtained by —THE ENDO CLINIC‖ – a clinic at Jodhpur city run by a renowned endocrinologist. Sample selection: The entire sample was selected from THE ENDO CLINIC as it has nearly eighty percent of daily OPD of patients from middle to higher income group diagnosed with diabetes mellitus. Therefore, subjects were purposively selected

from this clinic to get the reliable data which justifies the topic of the above study. Sample size: A sample size of total 310 subjects were selected through scattered purposive sampling technique. Subjects were selected using following criteria: T

57 For collecting data on frequent consumption of local food items in their daily meals:- 1. 300 subjects (150 males and 150 females) 2. Age between 35 -45 years. 3. Subjects who were diagnosed with type 2 diabetes mellitus. 4. Willingness to participate in the study. For estimation of glycemic index of listed testing food and reference food. 1. 10 subjects (5 males and 5 females) 2. Age between 30 -40 years. 3. Subjects with normoglycemia (non diabetic)/ normal blood glucose level. 4. Willingness to participate. TOOLS Tools were designed to collect required information from the subjects as per the need of the study. Data collection An interview schedule was developed to obtain the desired information from the subjects, which included :- 1. Socio demographic profile:- This includes the general information about the subjects regarding their age, education andfood habits. 2. 24 hour dietary recall method:- A 24 hour dietary recall (self-administered) questionnaire was developed as per FAO (2018) guidelines in which detail information about the quantity,

58 frequency, intake pattern of foods consumed throughout the day were listed and recorded. 3. Food frequency questionnaire:- Food frequency questionnaire performa (Appendix) was developed to obtain frequently consumed food items in a day ,week or a month. FOOD FREQUENCY TABLE Food items Once a week Twice a week On weekends Once in a month Rarely Poha Upma Besan Paratha Besan cheela Raab Patoliya Gatte ki sabji Pittor ki sabji Papad ki sabji Bdi ki sabji Kabuli Dal Bati Mirchiwada Kachori Samosa

59 PLATE – 1 Plate showing test foods Poha and Upma

60 PLATE – 2 Test food besan paratha and besan cheela

61 PLATE – 3 Test food raab and patoliya

62 PLATE – 4 Test food gatte and pittor ki sabji

63 PLATE – 5 Test food papad and badi ki sabji

64 PLATE – 6 Test food kabuli and dal bati

65 PLATE – 7 Test food mirchiwada, kachori and samosa

66 Tools used for the estimation of glycemic index of listed foods:- Glycemic index formula given by Jenkins et.at 1981 was used in the study. Where, IAUC is incremental area under curve. Test food is 50 g digestible carbohydrate from test food. Reference food is 50 g glucose. (For reference food, 50g of dextrose (Glucon−D glucose powder, Heinz India (P) Ltd., Mumbai, India) was dissolved in 200 ml of water and was given to subjects.) To calculate the incremental area under curve IAUC, a mathematical rule called trapezoid rule is used for calculation of IAUC. TRAPEZOID RULE IS CALCULATED BY USING THE FORMULA GIVEN BELOW :- ½ × (SUM OF PARELLEL LINES) × WIDTH OGTT(Oral Glucose Tolerence Test)Tool: OGTT was performed by using pre calibrated automatic lancet device-SD Code free blood glucose meter, produced by SD Biosensor , a diagnostic company from South Korea. This meter is used in the recording of sample as it meets the 2013 ISO standards for blood glucose meter accuracy. Fating state blood samples were taken by finger pricked capillary method at zero minute which was taken as baseline. The subjects were then asked to consume the reference / test food. Time was noted and further blood samples were obtained at 0 hour, 1 hour and 2 hour time frame.

67 The blood glucose respone curves were plotted for the reference and test foods. Further IAUC (incremental area under curve) were calculated geometrically using the trapezoid rule (FAO/WHO 1995). PLATE – 8 Plate showing reference food glucose

68 PLATE – 9 Electronic glucometer used for capillary blood test

69 PLATE – 10 Finger pricking and sample collection and Glucometer reading

70 FLOWCHART OF THE STEPS FOLLOWED FOR THE REFERENCE AND TEST FOOD CONSUMPTION. CONSUMPTION OF REFERENCE FOOD AND BLOOD SUGAR RESPONSE MEASURED ↓ After 2 days CONSUMPTION OF TEST FOOD 1 AND BLOOD SUGAR RESPONSE MEASURED ↓ After 2 days CONSUMPTION OF TEST FOOD 2 AND BLOOD SUGAR RESPONSE WAS MEASURED ↓ After 2 days CONSUMPTION OF n…..TEST FOODS AND BLOOD SUGAR RESPONSE WAS MEASURED TABLE SHOWING INGREDIENTS OF TEST FOOD Poha Weight (g) Carbohydrate (g) Poha 60 46.38 Tomato 20 0.72 Peanuts 10 2.67 Oil 10 0 Upma Weight (g) Carbohydrate (g) Semolina 65 48.62 Tomato 20 0.72 Onion 10 2.52 Ghee 10 0

71 Besan paratha Weight (g) Carbohydrate (g) Gram flour 20 12.18 Wheat flour 55 38.17 Oil 10 0 Besan cheela Weight (g) Carbohydrate (g) Gram flour 80 48.72 Green chilli 5 0.45 Coriander 5 0.31 Oil 10 0 Raab Weight (g) Carbohydrate (g) Bajra

flour 72 48.6 Buttermilk 250ml 1.2 Patoliya Weight (g) Carbohydrate (g) Bajra flour 75 50.06 Ghee 15 0 Gatte ki sabji Weight (g) Carbohydrate (g) Gram flour 80 48.72 Curd 50 1.5 Oil 15 0 Pittor ki sabji Weight (g) Carbohydrate (g) Gram flour 80 48.72 Curd 50 1.5 Oil 15 0 Papad ki sabji Weight (g) Carbohydrate (g) Urad dal(2 papads) 80 50.08 Oil 10 0

72 Badi ki sabji Weight (g) Carbohydrate (g) Moong dal(10 small nuggets) 88 49.8 Oil 10 0 Khichdi (kabuli) Weight (g) Carbohydrate (g) Rice 45 35.1 Bread(1/2 slice) 10 5.1 Cashew 10 2.23 Ghee 15 0 Gatte 10 6.9 Paneer 10 0.24 Dal bati Weight (g) Carbohydrate (g) Dal 25 14.9 Bati 50 34.7 Ghee 10 0 Mirchiwada Weight (g) Carbohydrate (g) Gram flour 75 45.67 Potato 20 4.52 Oil 60 0 Green chilli 5 0.45 Kachori Weight (g) Carbohydrate (g) Refined flour 55 40.6 Mogar dal 15 9.01 Oil 50 0 Samosa Weight (g) Carbohydrate (g) Refined flour 60 44.3 Cashew 10 2.23 Potato 20 4.52 Oil 60 0

73 Coping Tool: Group Counselling through lecture method: On the basis of research findings, a coping tool was developed in which all the selected diabetic subjects who participated in the study were called and through lecture method and on the basis of medical nutrition therapy given by American Diabetes Association, group counselling was conducted to educate subjects about understanding carbohydrate quality and quantity, its effects after digestion, knowing the portion size, understanding immediate and delayed blood glucose response, understanding importance of right selection of food and making correct choices, understanding non - scientific myths regarding specific food consumption at regional level and above all, most importantly understanding the response of local foods available and prepared at home and its effects on their blood glucose levels thus resulting in making wise choices while selecting and making food choices for their daily plate of meal. Counselling points included :- ➢ Type of carbohydrate. ➢ Amount of fibre ➢ Type of preparation ➢ Cooking methods ➢ Importance of fibre in meal was discussed as itincreases theintestinal transmit time, delays gastric emptying and slows down glucose absorbtion. ➢ Refined foods like sooji, maida should be avoided as they are low in fibre and hence increases faster breakdown of sugars and starches resulting in high glucose levels. ➢ Smaller the particle size, more is the glycemic effect.

74 ➢ Raw foods having larger particles, therefore have a lower effect than cooked homogenized foods. ➢ Foods cooked by dry and short time methods like roasting have a lesser glycemic effects as compared to foods cooked by boiling and long coking process which reduce particle size. ➢ Preparations like roasted chana, chapatis, sprouts and whole fruits are more suitable than khichri or boiled rice. ➢ Misconceptions regarding gram flour(as its said besan reduces blood glucose level post meal) was proved wrong in the above study as test foods like mirchiwada and besan cheela are high in G.I. whereas besan parantha which has mixed grain was comparatively less on G.I. scale in the result.

75 PLATE – 11 Counselling session 1

76 PLATE – 12 Counselling session 2

77 PLATE – 13 Counselling session 3

78

Percent was used for presenting information regarding background. Mean values were calculated for the data obtained from food frequency questionnaire as to assess the frequency of consumption of local food pattern . T – test for difference between two means was applied for assessing the difference between reference food and test food . Coefficient of correlation was used to find out relationship between reference food and test food. Formulas used for analysis of data are given below (Gupta, 1992) Mean = ∑ ∑X= Sum of all the observation values N= Total number of items

for difference between two means: In experimental work, generally it becomes necessary to test whether two samples differ from one other significantly in their means or whether they may be regarded as belonging to same population. ( ) √ ( ) ( ) x 1 = mean of reference food x 2 = mean of test food S 1 = standard deviation of reference food S 2 = standard deviation of test food n = number of items Coefficient of correlation When two variables cannot be considering the light

of dependence , and independence , in such cases with fair certainty that there is a relation of some sort and the type of relation is to be estimated along with the extent of two variables varying together sand influencing each other, coefficient of correlation is used . A measure of the degree of the relationship between the two variables which may be independent of any particular unit is needed . Karl Pearson developed such a

80 coefficient which may measure the degree of relationship or association This coefficient is Coefficient of Correlation and is denoted by r, its formula is given as under— (∑) (∑)(∑) √[∑ (∑)][∑ (∑)] r = coefficient of correlation n = number of subjects x and y are the obtained raw scores of the subjects respectively.

Chapter-4 RESULTS AND DISCUSSION

82 Chapter – 4 RESULTS AND DISCUSSION The present study was carried out at THE ENDO CLINIC of Jodhpur city, Rajasthan to estimate glycemic index of local foods consumed by diabetic patients of jodhpur city and its impact on their blood glucose level. Accordingly, a total 310 subjects were studied out of which 150 males and 150 females aged between 35-45 years were selected. The data includes general information on the basis of age, education, eating habits. The more emphasis was given over the consumption pattern of local foods on the basis of their daily meal pattern so as to list out the frequently consumed food items. General information:- On the basis of table no.4.1, 4.2 and 4.3 information regarding age, education and eating habits are shown in percentage with respective graphical representation. Percentage distribution of foods on the basis of their consumption frequency (Table 4.4 –Table 4.18) The first part of the study included 300 samples. Out of which 150 males and 150 females aged 35-45 years. On the basis of food frequency questionnaire and 24 hour dietary recall questionnaire.

83 Table 4.1 Percentage distribution of subjects as per age. Age Male subjects (n = 150) (In %) Female subjects (n = 150) (In %) Age 35=40 years 41.33 24 Age 40-45 years 52 76 Table 4.1 shows those 41%

males and 24% females

62%	MATCHING BLOCK 7/24	SA	C VD Methodology and Results Discussion.docx (D30208825)

were under the age group of 35-40 years whereas 52% males and 76% females were under the age group of 40- 45 years

of age. Percentage distribution of subjects as per age 80 70 60 50 40 Age 35=40 years Age 40-45 years 30 20 10 0 Male subjects Female subjects Percentage

84 Table 4.2 Percentage distribution of subjects on the basis of education. Education Male subjects (n = 150) In % Female subjects (n=150) In % Literate 100 100 Illiterate 0 0 Table no. 4.2 shows percentage mean of subjects on the basis of education. the table shows that both the subjects were under the category of literate. None of them was under illiterate category.

52%	MATCHING BLOCK 8/24	SA	Vaishya.R.D(18FSN22)MSc Thesis (1) (3).pdf (D77694297)

Percentage distribution of subjects on the basis of Education 100 90 80 70 60 50 40 30 20 10 0 Literate Illiterate Male subjects Female subjects Percentage 85 Table 4.3 Percentage distribution of subjects on the basis of

eating habits. Eating habits Male subjects (n=150) In % Female subjects (n=150) In % Vegetarian 100 100 Non vegetarian 0 0 Table 4.3 shows percentage distribution on the basis of eating habits, where both the subjects were under vegetarian category. Eating Habits 100 90 80 70 60 50 40 30 20 10 0 Vegetarian Non vegetarian Male subjects Female subjects Percentage

86 Table 4.4 Percentage distribution of subjects on the basis of consumption frequency of breakfast items listed below: Breakfast item Poha Male subjects (n=150) In % Female subjects (n=150) In % Once a week 42 46 Twice a week 32 27.33 On week ends 20 16 Monthly once 12 6.66 Rarely 10.66 4 Table 4.4 showed that the maximum in take frequency was once a week where in males it was 42% and in female subjects it was 46% respectively. Consumption frequency - Poha 50 45 40 35 30 25 20 15 10 5 0 Male subjects Female subjects Once a week Twice a week On week Monthly Rarely ends once Percentage

87 Table 4.5 Breakfast item Upma

100% MATCHING BLOCK 9/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n= 150) % Once a week 40 25.33 Twice a week 32.66 20

On week ends 15.33 30 Monthly once 8 21.33 Rarely 4 3.33 Table no. 4.5 of test food UPMA showed maximum intake frequency of once a week which in males was observed 40% whereas in females frequency was on weekends which was observed 30%. Consumption Frequency - Upma 40 35 30 25 20 15 10 5 0 Series1 Series2 Once a Twice a On week week week ends Monthly once Rarely Percentage

88 Table 4.6 Breakfast item Besan parantha Male (n=150) % Females (n=150) % Once a week 37.33 34 Twice a week 28 25.33 On week ends 18 18 Monthly once 12.66 16.66 Rarely 4 6 Table 4.6 of test food BESAN PARANTHA showed maximum intake once a week in males and females where in males it was observed 37.33% and in females it showed 34%. Consumption frequency - Besan Parantha 40 35 30 25 20 15 10 5 0 Male (n=150) Females (n=150) Once a week Twice a week On week Monthly Rarely ends once Percentage

89 Table 4.7 Breakfast items Besan cheela Male (n =150) % Females (n=150) % Once a week 32 35.33 Twicea week 22.66 24.66 On week ends 21.33 14.66 Monthly once 18.66 18.66 Rarely 5.33 6.66 Table 4.7 of test food BESAN CHEELA showed maximum intake frequency of once a week in both subjects, in males it observed 32% and in females it was 35.33%. Consumption frequency - Besan Cheela 40 35 30 25 20 15 10 5 0 Male (n =150) Females (n=150) Once a week Twicea week On week Monthly Rarely ends once Percentage

90 Table 4.8 Breakfast item Raab

100% MATCHING BLOCK 12/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 36 44.66 Twice a week 30.66 22.66

On week ends 15.33 8.99 Monthly once 26.66 20.66 Table 4.8 of test food RAAB showed maximum intake frequency of once a week in both the subjects, in males mean percentage was observed 36% and among females it was 44.66%. Consumption frequency - Raab 45 40 35 30 25 20 15 10 5 0 Male (n=150) Female (n=150) Once a week Twice a On week Monthly week ends once Percentage

91 Table 4.9 Breakfast item Patoliya Male (n=150) % Females (n=150) % Once a week 38 32.66 Twice a week 19.33 24.66 On week ends 20 17.33 Monthly once 22.66 16.06 Rarely 16.66 14.66 Table 4.9 of test food PATOLIYA showed maximum intake frequency of once a week in both the subjects, in males it was observed 38% and in females it was 32.66%. Consumption

62% MATCHING BLOCK 10/24 SA Sona thesis.doc (D21444835)

frequency - Patoliya 40 35 30 25 20 15 10 5 0 Male (n=150) Females (n=150) Once a week Twice a week On week Monthly Rarely

ends once Percentage

92 Table 4.10 Percentage distribution of subjects on the basis of frequently consumption of local vegetables / homemade recipes in lunch. Local vegetables consumed in lunch Gatte ki sabji

100% MATCHING BLOCK 11/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 25.33 29.33 Twice a week 27.33 33.33

On week ends 42.66 25.33 Monthly once 16 24.66 Rarely 2.66 4 Table 4.10 of test food GATTE KI SABJI it was observed that in male subjects maximum intake is on weekends which was observed 42.66% and among females maximum intake was twice a week which showed 33.33%. Consumption frequency Gatte ki Sabji 45 40 35 30 25 20 15 10 5 0

83% MATCHING BLOCK 15/24 SA Sona thesis.doc (D21444835)

Male (n=150) Female (n=150) Once a Twice a On week Monthly Rarely

week week ends once Percentage

93 Table 4.11 Local veg consumed in lunch Pittor ki sabji

100% MATCHING BLOCK 13/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 36 32.66 Twice a week 25.33 24.66

On week ends 20 19.33 Monthly once 27.33 26.66 Rarely 8 13.33 Table 4.11 of test food PITTOR KI SABJI showed maximum intake frequency of once a week in both the subjects where in males it was observed 36% and females it was 32.66%. Consumption frequency Pittor Sabji 40 35 30 25 20 15 10 5 Male (n=150) Female (n=150) 0 Once a Twice a On week week week ends Monthly once Rarely Percentage

94 Table 4.12 Local vegetables consumed in lunch Badi (Moong dal nuggets) Male (n=150) % Females (n=150) % Once a week 44.66 58.66 Twice a week 12.66 25.33 On weekends 22 12 Monthly once 32.66 16.66 Rarely 4.66 4 Table 4.12 of test food MOONG DAL BADI showed maximum intake frequency of once a week in both the subjects, in males the mean observed was 44.66% and in females it was 58.66%. Consumption frequency - Badi (Moong Dal Nuggets) 60 50 40 30 20 Male (n=150) Females (n=150) 10 0 Once a week Twice a On Monthly Rarely week weekends once Percentage

95 Table 4.13 Local veg consumed in lunch Papad ki sabji

100% MATCHING BLOCK 14/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 48.66 40.66 Twice a week 26 22

On week ends 12 16 Monthly once 20 21.33 Rarely 10 16.66 Table 4.13 of test food PAPAD KI SABJI showed maximum intake frequency of once a week in both subjects, in males it was observed 48.66% and in females it was observed 40.66%. Consumption frequency - Papad ki Sabji 50 45 40 35 30 25 20 15 10 5 0 Male (n=150) Female (n=150) Once a Twice a On week week week ends Monthly once Rarely Percentage

96 Table 4.14 Percentage distribution of subjects on the basis of frequently consumed local street snacks . Consumption pattern of Local street snacks Mirchiwada

100% MATCHING BLOCK 16/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 46 34.66 Twice a week 22.66 11.33

On week ends 36 26.66 Monthly once 5.33 36 Rarely 6.66 8 Table 4.14 of test food MIRCHIWADA showed maximum intake frequency of once a week, in male sit was 46% wheras in female subjects it was 34.66%. Consumption frequency snacks - Mirchiwada 50 45 40 35 30 25 20 15 10 5 0

78% MATCHING BLOCK 17/24 SA Sona thesis.doc (D21444835)

Male (n=150) Female (n=150) Once a week Twice a week On week Monthly Rarely

ends once Percentage

97 Table 4.15 Consumption frequency of local street food Mogar kachori (small) Male (n=150) % Females (n=150) % Once a week 29.33 14 Twice a week 12 10.66 On week ends 36.66 40.66 Monthly once 30.66 45.33 Rarely 8 6 Table 4.15 of food MOGAR KACHORI showed maximum intake frequency in males was 36.66% (on week ends) wheras in females it was observed monyhly once at 45.33%. Consumption frequency snacks - Mogar Kachori Small 50 45 40 35 30 25 20 15 10 5 0 Male (n=150) Females (n=150) Once a week Twice a week On week Monthly Rarely ends once Percentage

98 Table4.16 Consumption frequency of local street foods Samosa (small)

100%	MATCHING BLOCK 18/24	SA	Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 12 14 Twice a week 8.99 6.66

On week ends 52.66 21.33 Monthly once 34 51.33 Rarely 9.33 23.33 Table 4.16 of food SAMOSA it showed on week ends frequency of 52.66% in males whereas monthly once frequency in females of 51.33% Consumption frequency snacks - Samosa Small 60 50 40 30 20

78%	MATCHING BLOCK 19/24	SA	Sona thesis.doc (D21444835)

Male (n=150) Female (n=150) 10 0 Once a week Twice a week On week Monthly Rarely

ends once Percentage

99 Table 4.17 Percentage distribution of subjects on the basis of consumption frequency of occasional local delicacies. Local occasional delicacies Khichdi (marwadi pulav with vegetables)

100%	MATCHING BLOCK 21/24	SA	Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 32.66 37.33 Twice a week 8.99 12

On week ends 30.66 44.66 Monthly once 39.33 20.66 Rarely 5.33 2 Table 4.17 of food KHICHDI showed intake frequency of monthly once in males with 39.33% whereas in female subjects it was onbserved 44.66% on week ends. Consumption frequency - Khichdi (Marwari Pulav with Vegetables) 50 40 30 20

78%	MATCHING BLOCK 20/24	SA	Sona thesis.doc (D21444835)

Male (n=150) Female (n=150) 10 0 Once a week Twice a week On week Monthly Rarely

ends once Percentage

100 Table 4.18 Local occasional delicacies Dal baati Males (n=150) % Females (n=150) % Once a week 25.33 26.66 Twice a week 10 8.99 On week ends 32.66 26 Monthly once 45.33 44 Rarely 3.33 11.33 Table 4.18 of food DAL- BAATI showed maximum intake frequency of monthly once in both the subjects where in males it showed 45.33% and in female subjects it was 44 respectively. Consumption Frequency - Daal Baati 50 45 40 35 30 25 20 15 10 5 0 Males (n=150) Females (n=150) Once a week Twice a week On week Monthly Rarely ends once Percentage

101 SECOND PART OF THE STUDY As the study was carried out to estimate the glycemic index of foods listed from food frequency method, ten

100%	MATCHING BLOCK 23/24	SA	Supriya v.docx (D93456152)

subjects who were willing to participate in the study were

selected with normoglycemia (normal blood glucose level) and who fall under normal category of BMI as per the guidelines given by WHO for the population living in Asia, BMI of 23 kg/m 2 indicated acceptable. Healthy volunteers between 30 to 40 years of age having BMI in between the range of 19.1 and 22.9kg/m 2 were selected. Subjects not lying in this category were excluded from the study. As to carry out the findings of study on 10 healthy subjects, BMI was calculated and all healthy individuals were falling under the range of 19 -24.9 which is considered as normal range of BMI (WHO, 2008).

102 Ref. Food Glucose(50g) 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Tables 4.19- 4.34 showing tabulation and graphical representation of blood glucose screening for all 15 selected test food and reference food(constant –glucose) at 0 hour, 1 hour, 2 hour and its incremental area under curve (IAUC) 50 g glucose o hour 1 hour 2 hour IAUC Subject 1 98

109 87 201 Subject 2 99 124 97 226 Subject 3 88 110 88 198 Subject 4 79 93 91 178 Subject 5 84 106 88 192 Subject 6 78 99 84 180 Subject7 80 112 108 206 Subject 8 103 120 111 227 Subject 9 90 106 101 201.5 Subject 10 91 103 97 197 Mean IAUC OF 50 G GLUCOSE C OF 50g GLUCOSE 200.6

103 Test food POHA 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC OF POHA o hour 1 hour 2 hour IAUC Table 4.20 for test food POHA POHA o hour 1 hour 2 hour IAUC Subject 1 86 116 140 229 Subject 2 80 104 125 206.5 Subject 3 94 112 110 214 Subject 4 99 120 126 232.5 Subject 5 89 97 117 200 Subject 6 91 103 106 201.5 Subject 7 98 110 107 212.5 Subject 8 93 120 126 229.5 Subject 9 89 113 121 218 Subject 10 100 119 130 234 MEAN IAUC OF POHA 217.75

104 Test food upma 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject7 Subject Subject Subject MEAN 1 2 3 4 5 6 8 9 10 IAUC OF UPMA o hour 1 hour 2 hour IAUC Table 4.21 for test food UPMA UPMA o hour 1 hour 2 hour IAUC Subject 1 78 130 110 224 Subject 2 88 121 106 218 Subject 3 80 102 98 191 Subject 4 84 94 96 184 Subject 5 92 106 97 200.5 Subject 6 96 116 110 219 Subject7 89 109 97 202 Subject 8 98 120 111 224 Subject 9 83 117 110 213.5 Subject 10 86 121 101 214.5 MEAN IAUC OF UPMA 209.05

105 Test food BESAN KA PARATHA 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Table 4.22 for test food BESAN KA PARATHA BESAN KA PARATHA o hour 1 hour 2 hour IAUC Subject 1 80 117 112 213 Subject 2 78 106 102 196 Subject 3 84 96 93 184.5 Subject 4 88 98 86 185 Subject 5 74 86 81 163.5 Subject 6 89 92 80 176.5 Subject 7 79 86 81 166 Subject 8 82 93 87 177.5 Subject 9 81 89 83 171 Subject 10 96 102 99 199.5 MEAN IAUC OF BESAN KA PARATHA 164.74

106 Test Food BESAN CHEELA 300 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR BESAN CHEELA o hour 1 hour 2 hour IAUC Table 4.23 for BESAN CHEELA BESAN CHEELA o hour 1 hour 2 hour IAUC Subject 1 89 133 120 237.5 Subject 2 88 124 109 222.5 Subject 3 94 119 106 219 Subject 4 91 124 118 228.5 Subject 5 87 130 121 234 Subject 6 89 128 116 230.5 Subject 7 96 118 104 218 Subject 8 81 129 120 229.5 Subject 9 79 113 110 207.5 Subject 10 100 131 124 243 MEAN IAUC FOR BESAN CHEELA 227

107 Table 4.24 for test food RAAB 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC OF RAAB o hour 1 hour 2 hour IAUC Table 4.24 for test food RAAB RAAB o hour 1 hour 2 hour IAUC Subject 1 78 84 81 163.5 Subject 2 88 92 91 181.5 Subject 3 90 96 94 188 Subject 4 96 99 93 193.5 Subject 5 100 105 98 204 Subject 6 80 86 85 168.5 Subject 7 98 106 101 205.5 Subject 8 90 98 92 189 Subject 9 79 88 83 169 Subject 10 83 96 91 183 MEAN IAUC OF RAAB 184.5

108 Test food PATOLIYA 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Table 4.25 for test food PATOLIYA PATOLIYA o hour 1 hour 2 hour IAUC Subject 1 80 87 84 169 Subject 2 72 88 83 165 Subject 3 81 94 88 178.5 Subject 4 86 91 89 178.5 Subject 5 97 100 94 195.5 Subject 6 93 99 95 193 Subject 7 89 93 90 182.5 Subject 8 84 94 92 182 Subject 9 81 89 87 173 Subject 10 97 100 94 195.5 MEAN IAUC OF PATOLIYA 181.2

109 Test food GATTE KI SABJI 300 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR GATTE KI SABJI o hour 1 hour 2 hour IAUC Table 4.26 for test food GATTE KI SABJI GATTE KI SABJI o hour 1 hour 2 hour IAUC Subject 1 88 133 122 238 Subject 2 86 137 119 239.5 Subject 3 79 129 117 227 Subject 4 84 109 105 203.5 Subject 5 96 119 110 222 Subject 6 89 124 116 226.5 Subject 7 87 130 116 231.5 Subject 8 99 128 120 237.5 Subject 9 98 117 105 218.5 Subject 10 84 109 101 201.5 MEAN IAUC FOR GATTE KI SABJI 224.5

110 Test food PITTOR KI SABJI 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IUAC FOR PITTOR KI SABJI o hour 1 hour 2 hour IAUC Table 4.27 for test food PITTOR KI SABJI PITTOR KI SABJI o hour 1 hour 2 hour IAUC Subject 1 87 128 122 232.5 Subject 2 83 111 107 206 Subject 3 94 120 108 221 Subject 4 89 116 104 212.5 Subject 5 93 119 107 219 Subject 6 91 113 110 213.5 Subject 7 97 127 121 236 Subject 8 89 126 113 227 Subject 9 81 119 111 215 Subject 10 79 114 110 224 MEAN IUAC FOR PITTOR KI SABJI 220.6

111 Test food PAPAD KI SABJI 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR PAPAD KI SABJI o hour 1 hour 2 hour IAUC Table 4.28 for test food PAPAD KI SABJI PAPAD KI SABJI o hour 1 hour 2 hour IAUC Subject 1 84 89 85 173.5 Subject 2 88 86 83 171.1 Subject 3 96 99 94 194 Subject 4 92 99 96 193 Subject 5 81 86 85 169 Subject 6 79 84 83 165 Subject 7 97 103 100 201.5 Subject 8 83 91 89 177 Subject 9 80 92 84 174 Subject 10 94 101 99 197.5 MEAN IAUC FOR PAPAD KI SABJI 181.46

112 Test food BADI KI SABJI 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR BADIKI SABJI o hour 1 hour 2 hour IAUC Table 4.29 for test food BADI KI SABJI BADI KI SABJI o hour 1 hour 2 hour IAUC Subject 1 81 85 84 167.5 Subject 2 79 83 80 162.5 Subject 3 80 89

83 170.5 Subject 4 90 96 94 188 Subject 5 75 81 80 158.5 Subject 6 82 88 86 172 Subject 7 90 98 96 191 Subject 8 87 96 89 184 Subject 9 79 87 86 169.5 Subject 10 89 98 94 189.5 MEAN IAUC FOR BADIKI SABJI 175.3

113 Test food KABULI 300 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR KABULI o hour 1 hour 2 hour IAUC Table 4.30 for test food KABULI KABULI o hour 1 hour 2 hour IAUC Subject 1 90 124 80 209 Subject 2 98 134 114 240 Subject 3 96 123 111 226.5 Subject 4 94 119 104 218 Subject 5 89 131 101 226 Subject 6 83 123 107 218 Subject 7 91 126 110 226.5 Subject 8 87 133 121 237 Subject 9 93 120 109 221 Subject 10 97 129 106 230.5 MEAN IAUC FOR KABULI 225.2

114 Test food DAL BATI 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR DAL BATI o hour 1 hour 2 hour IAUC Table 4.31 for test food DAL BATI DAL BATI o hour 1 hour 2 hour IAUC Subject 1 78 133 101 22.5 Subject 2 86 129 109 226.5 Subject 3 76 120 113 214.5 Subject 4 88 119 104 215 Subject 5 81 124 106 218 Subject 6 79 120 108 213.5 Subject 7 89 123 101 218 Subject 8 93 127 99 223 Subject 9 84 119 103 211.5 Subject 10 90 110 98 204 MEAN IAUC FOR DAL BATI 216.5

115 Test food MIRCHIWADA 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Table 4.32 for test food MIRCHIWADA MIRCHIWADA o hour 1 hour 2 hour IAUC Subject 1 86 104 117 205 Subject 2 90 116 109 215.5 Subject 3 96 126 114 231 Subject 4 89 109 106 206.5 Subject 5 93 107 101 204 Subject 6 88 99 96 191 Subject 7 86 101 94 191 Subject 8 92 107 100 203 Subject 9 97 119 106 220 Subject 10 88 119 104 214.5 MEAN IAUC FOR MIRCHIWADA 208.15

116 Test food KACHORI 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Table 4.33 for test food KACHORI KACHORI o hour 1 hour 2 hour IAUC Subject 1 94 123 127 233.5 Subject 2 91 118 121 224 Subject 3 98 116 113 221.5 Subject 4 89 120 109 219 Subject 5 97 124 120 232.5 Subject 6 86 119 112 218 Subject 7 94 108 104 207 Subject 8 98 118 126 230 Subject 9 100 126 120 236 Subject 10 93 113 109 214 MEAN IAUC FOR KACHORI 223.5

117 Test food SAMOSA 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR SAMOSA o hour 1 hour 2 hour IAUC Table 4.34 for test food SAMOSA SAMOSA o hour 1 hour 2 hour IAUC Subject 1 98 126 116 233 Subject 2 88 118 104 214 Subject 3 87 104 99 197 Subject 4 93 113 104 211 Subject 5 90 115 109 214 Subject 6 88 120 111 219.5 Subject 7 96 123 116 229 Subject 8 94 121 107 221.5 Subject 9 99 129 117 231 Subject 10 89 113 106 210 MEAN IAUC FOR SAMOSA 199.6

118 CALCULATED GLYCEMIC INDEX FOR 15 TEST FOOD TAKEN 250 200 150 100 50 0 Mean IAUC G.I. TABLE 4.35 SHOWING CALCULATED GLYCEMIC INDEX FOR 15 TEST FOOD TAKEN Ref. food Mean IAUC Ref. food 50 g Glucose 200.6 POHA 217.75 108.54 UPMA 209.05 104.21 BESAN KA PARATHA 164.74 82.12 BESAN KA CHEELA 227 113.1 RAAB 184.5 91 PATOLIYA 181.2 90.35 GATTE KI SABJI 224.5 111.9 PITTOR KI SABJI 220.6 109.9 PAPAD KI SABJI 181.4 90.4 BADI KI SABJI 175.3 87.3 KABULI 225.2 112.28 DAL BATI 216.6 108 MIRCHIWADA 208.15 103.7 KACHORI 223.5 111.4 SAMOSA 199.6 99.5

119 G.I CLASSIFICATION TABLE Classification of GI on the basis of result findings Reference : American Journal Of Clinical Nutrition (July 2002) High GI foods (Rank 100+) Moderately high GI foods (Rank 80-99) Low GI foods (Rank >80) POHA – 108.5 BESAN PARATHA – 82.12 UPMA – 104.2 SAMOSA – 99.5 KACHORI – 111.4 RAAB – 91 MIRCHIWADA – 103.7 BADI KI SABJI – 87.3 BESAN CHEELA – 113.1 PATOLIYA – 90.3 KHICHDI – 112.2 PAPAD KI SABJI – 90.4 PITTOR KI SABJI – 109.9 DAL BATI - 108 GATTE KI SABJI – 111.9

120 Statistical analysis Statistical analysis of selected test foods and calculation of t - test of food is given below:- Table 4.36- 4.51 showing t – TEST Calculations and results Table 4.36 The above table no. 4.36 for reference food glucose (50 g) shows t – value for 0-1 hour (4.75) which is statistically highly significant. At 0-2 hour t- value is (1.53) which is not significant and at 1-2 hour t- value is 3.15 which is highly significant. The above statistical result shows there was peak rise in glucose level at 0-1 hour but post prandial glucose dropped to normal glucose level in testing subjects who were non diabetic. REF. FOOD N MEAN STANDARD DEVIATION 't' 0 HOUR 1 HOUR 10 10 89.0000 108.2000 8.8819 9.1869 4.75 ** 0 HOUR 2 HOUR 10 10 89.0000 95.2000 8.8819 9.2352 1.53 NS 1 HOUR 2 HOUR 10 10 108.2000 95.2000 9.1869 9.2352 3.156 **

121 Table 4.37 POHA N MEAN STANDARD DEVIATION 't' 0 HOUR 1 HOUR 10 10 91.9000 111.4000 6.2619 7.9190 6.10 ** 0 HOUR 2 HOUR 10 10 91.9000 120.8000 6.2619 10.8812 7.28 ** 1 HOUR 2 HOUR 10 10 111.4000 120.8000 7.9190 10.8812 2.20 * The t-value for 0-1 hour is (6.10) , 0-2 hour(7.28) and 1-2(2.20) hour were highly significant and significant respectively. Hence, test food poha shows peak rise in glucose levels post prandial results.

122 Table no. 4.38 UPMA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 87.4000 113.6000 6.5524 10.7207 6.59 ** 0 HOUR 2 HOUR 10 10 87.4000 103.6000 6.5524 6.3805 5.60 ** 1 HOUR 2 HOUR 10 10 113.6000 103.6000 10.7207 6.3805 2.53 * The t-value for 0-1 hour is (6.59) , 0-2 hour(5.60) and 1-2 hour (2.53) were highly significant and significant respectively. Hence, test food upma shows peak rise in glucose levels post prandial results

123 Table 4.39 BESAN KA PARATHA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 83.1000 96.5000 6.3849 9.7325 3.64 ** 0 HOUR 2 HOUR 10 10 83.1000 90.4000 6.3849 10.8136 1.83 NS 1 HOUR 2 HOUR 10 10 96.5000 90.4000 9.7325 10.8136 1.32 NS The t- value for 0-1 hr is (3.64), 0-2 hour (1.83) and 1-2 hour (1.32) were highly significant and not significant respectively. Hence, test food besan parantha shows peak rise in glucose level at 0-1 hour but later drops down to normal level post prandial.

124 Table 4.40 BESAN CHEELA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 89.4000 124.9000 6.3805 6.5056 12.32 ** 0 HOUR 2 HOUR 10 10 89.4000 114.8000 6.3805 6.9889 8.48 ** 1 HOUR 2 HOUR 10 10 124.9000 114.8000 6.5056 6.9889 3.34 **(t- value for test food besan cheela at 0-1 hour(12.32), 0-2hour(8.48) and 1-2 hour (3.34) shows that they are highly significant. Hence, it shows that besan cheela has peak rise in blood glucose level post prandial.

125 Table 4.41 RAAB N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 88.2000 95.0000 8.0664 7.5130 1.95 NS 0 HOUR 2 HOUR 10 10 88.2000 90.9000 8.0664 6.3500 0.83 NS 1 HOUR 2 HOUR 10 10 95.0000 90.9000 7.5130 6.3500 1.31 NS t- value for test food raab at 0-1 hour (1.95) , 0-2 hour(0.83) and 1-2 hour (1.31)shows that they are not significant. Hence , it shows that raab has no remarkable rise in post prandial glucose level.

126 Table 4.42 PATOLIYA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 86.0000 93.5000 8.0691 4.8819 2.51 * 0 HOUR 2 HOUR 10 10 86.0000 89.6000 8.0691 4.1952 1.25 NS 1 HOUR 2 HOUR 10 10 93.5000 89.6000 4.8819 4.1952 1.91 NS t – value for test food patoliya at 0-1 hour (2.51), 0-2 hour(1.25) and 1-2 hour (1.91) shows significance at 0-1 hour and not significant for other two variables respectively. Hence , it shows that patoliya gives peak rise in blood glucose level in first hour but drops down to normal level post prandial.

127 Table 4.43 GATTE KI SAJI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 89.0000 123.5000 6.6165 9.7079 9.28 ** 0 HOUR 2 HOUR 10 10 89.000 113.1000 6.6165 7.3098 7.73 ** 1 HOUR 2 HOUR 10 10 123.5000 113.1000 9.7097 7.3098 2.70 * T – value for test food gate ki sabji at 0-1 hour(9.28) , 0-2 hour (7.33) and 1-2 hour(2.70) shows high signifance and significance respectively. Hence it shows there is peak rise in blood glucose level post prandial

128 Table 4.44 PITTOR KI SAJI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 88.3000 119.3000 5.8509 6.0378 11.66 ** 0 HOUR 2 HOUR 10 10 88.3000 111.3000 5.8509 5.9264 8.73 ** 1 HOUR 2 HOUR 10 10 119.3000 111.3000 6.0378 5.9264 2.99 ** t– value for test food pittor ki sabji at 0-1 hour (11.66) , 0-2 hour (8.73) and 1-2 hour (2.99) shows high significance. Hence, it gives peak rise in blood glucose at post prandial level.

129 Table 4.45 PAPAD KI SABJI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 87.4000 93.0000 6.8993 6.9602 1.80 NS 0 HOUR 2 HOUR 10 10 87.4000 89.8000 6.8993 6.8118 0.78 NS 1 HOUR 2 HOUR 10 10 93.0000 89.9000 6.9602 6.8118 1.03 NS t- value for test food papad ki sabji at 0-1hour (1.80), 0-2 hour(0.78) and at 1-2 hour(1.03) shows no significance. Hence, no prominent increase in blood glucose at post prandiallevel.

130 Table 4.46 BADI KI SABJI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 83.200 90.1000 5.2707 6.4023 2.61 * 0 HOUR 2 HOUR 10 10 83.2000 87.2000 5.3707 5.8462 1.59 NS 1 HOUR 2 HOUR 10 10 90.1000 87.2000 6.4023 5.8462 1.05 NS t- value for badi ki sabji at 0-1 hour(2.61), 0-2 (1,59) 1-2 (1.05) shows significance at 0-1 hour and no significance for other two variables respectively.Hence, there is no remarkable rise in blood glucose at post prandial.

131 Table 4.47 KABULI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 91.8000 126.2000 4.7329 5.3083 15.29 ** 0 HOUR 2 HOUR 10 10 91.8000 106.3000 4.7329 10.7708 3.89 ** 1 HOUR 2 HOUR 10 10 126.2000 106.3000 5.7194 10.7708 5.24** t- value for test food kabuli at 0-1 hour(15.29) at 0-2 hour(3.89) at 1-2 hour (5.24) were highly significant. Hence, it shows peak rise in blood glucose level post prandial.

132 Table 4.48 DAL BATI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 84.4000 122.4000 5.7194 6.3979 14.00 ** 0 HOUR 2 HOUR 10 10 84.4000 104.2000 5.7219 4.7796 8.40 ** 1 HOUR 2 HOUR 10 10 122.4000 104.2000 6.3979 4.7796 7.20 ** t- value for test food daal- baati at 0-1 hour(14.00) at 0-2 hour(8.40) at 1-2 hour (7.20) were highly significant. Hence, it shows peak rise in blood glucose level post prandial.

133 Table 4.49 MIRCHIWADA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 90.5000 110.7000 3.8944 8.8575 6.60 ** 0 HOUR 2 HOUR 10 10 90.5000 104.7000 3.8944 7.3492 5.39 ** 1 HOUR 2 HOUR 10 10 110.7000 104.7000 8.8575 7.3492 1.64 NS t- value for test food mirchiwada at 0-1 hour(6.60) at 0-2 hour(5.39) at 1-2 hour (1.64) were highly

significant at first two variables but no significance was seen at 1-2 hours. Hence, it shows rise in blood glucose level post prandial.

134 Table 4.50 KACHORI N MEAN STANDARD DEVIATION 't' 0 HOUR 1 HOUR 10 10 94.0000 118.5000 4.4222 5.3385 11.17 ** 0 HOUR 2 HOUR 10 10 94.0000 116.1000 4.4222 7.7810 7.80 ** 1 HOUR 2 HOUR 10 10 118.5000 116.1000 5.3385 7.7810 0.80 NS t- value for test food kachori at 0-1 hour(11.17) at 0-2 hour(7.80) at 1-2 hour (0.80) were highly significant at first two variables but no significance was seen at 1-2 hours. Hence, it shows rise in blood glucose level post prandial.

135 Table 4.51 SAMOSA N MEAN STANDARD DEVIATION 't' 0 HOUR 1 HOUR 10 10 92.2000 118.2000 4.4171 7.2847 9.65 ** 0 HOUR 2 HOUR 10 10 92.2000 108.9000 4.4171 6.0452 7.05 ** 1 HOUR 2 HOUR 10 10 118.2000 108.9000 7.2847 6.0452 3.10 ** t- value for test food samosa at 0-1 hour (9.65) at 0-2 hour (7.05) and at 1-2 hour (3.10) were highly significant . Hence it shows peak rise in glucose level post prandial. NOTE:- * denotes significance at 0.05 level. ** denotes significance at0.01 level.

136 Table 4.52, 4.53 and 4.54 showing the pearson's coefficient of correlation of test goods at o hour, 1 hour and 2 hour blood glucose screening. Table 4.52 showing correlation among the variable (reference food and test foods) at 0 hour of blood glucose screen Poha Upma Besan paratha Besan cheela Raab Patoliya Gatte ki sabji Pittor ki sabji Papad ki sabji Badi ki sabji Kabuli Dal bati Mirchiwada Kachori Samosa Ref. food -.493 -.053 -.202 -.369 -.349 -.557 .270 -.481 -.176 -.170 .217 .212 .135 .422 .159 Poha .028 .614 .541 .311 .600 -.276 .216 .562 .774 ** .022 .389 -.166 -.056 .001 Upma -.041 -.262 .257 .391 .515 .220 -.385 .102 -.613 .419 -.087 -.199 -.260 Besan paratha .493 -.374 .364 -.434 -.382 .284 .576 .129 .200 -.235 -.433 -.296 Besan cheela .195 .378 -.816 ** .154 .791 ** .458 .378 -.002 -.519 -.378 -.421 Raab .242 -.046 .625 .398 .168 .077 .282 .021 .084 =.182 Patoliya .102 .195 -.026 .223 -.381 .104 -.212 -.156 -.203 Gatte ki sabji -.115 -.767 ** -.272 -.536 .261 .306 .433 .483 Pittor ki sabji .203 .030 -.439 -.263 -.090 -.017 -.093 Papad ki sabji .567 .636 * .226 -.223 -.040 -.207 Badi ki sabji .063 .692 * -.531 -.304 .167 Kabuli .143 .187 .170 -.179 Dal bati -.215 .013 .199 Mirchiwada .684* -.071 Kachori .375 Samosa The above table 4.52 shows significance and correlation among two variables at 0-1 hour. Significance at .01 level (**) Very high significance and negative correlation among test food (gate ki sabji and besan ka cheela -.816). High significance and positive correlation among (papad ki sabji and besan ka cheela.791). High significance and negative correlation among(papad ki sabji and gate ki sabji -.767),High significance and positive correlation among (badi ki sabji and poha .774). Significance at .05 level(*) High significance and positive correlation among(kabuli and papad ki sabji .636).High significance and positive correlation among (dal baati and badi ki sabji .692). High significance and positive correlation among (kachori and mirchiwada .684).

137 Table 4.53 showing correlation among the variable (reference food and test foods) at 1 hour of blood glucose screen Poha Upma Besan paratha Besan cheela Raab Patoliya Gatte ki sabji Pittor ki sabji Papad ki sabji Badi ki sabji Kabuli Dal bati Mirchiwada Kachori Samosa Ref. food -.123 .467 .142 -.052 .053 -.342 .777 ** .245 -.210 -.195 .735 * .581 .144 -.186 .169 Poha .075 .346 .012 -.103 -.296 -.301 .318 .591 .707 * -.274 -.207 .213 -.176 .020 Upma .525 .388 -.604 -.217 .407 .158 -.411 -.203 .390 .361 -.122 .115 .592 Besan paratha .478 -.579 -.490 .269 -.010 -.123 -.169 .052 .366 .119 .121 .020 Besan cheela -.107 .352 -.024 .004 -.361 -.085 .435 .207 -.384 .088 -.096 Raab .388 -.200 .176 .478 .374 .306 -.192 -.055 -.468 -.382 Patoliya -.444 -.273 .026 .180 .219 -.583. -.109 -.245 -.431 Gatte ki sabji .340 -.350 -.380 .382 .794 ** -.163 -.136 .209 Pittor ki sabji .233 .200 -.044 .471 -.326 -.088 .370 Papad ki sabji .785 ** -.301 -.529 .308 -.655 * -.329 Badi ki sabji -.131 -.497 -.060 -.688 * -.115 Kabuli .305 -.029 -.216 -.059 Dal bati -.390 .283 .399 Mirchiwada .048 -.485 Kachori .297 Samosa Significance at .01 level (**) Highly significant and positive correlation among Gate ki sabji and ref food (.777) High significance and positive correlation among Badi ki sabji and papad ki sabji (.785) High significance andpositive correlation among dal baati and gate ki sabji (.794) Significance at .05 level(*) High significant and positive correlation among Badi ki sabji and poha (.707) High significance and positive correlation among Kabuli and reference food (.735) High significance and negative correlation among kachori and papad ki sabji (- .655) High significance and negative correlation among kachori and badi ki sabji(-688)

138 Table 4.54 showing correlation among the variable (reference food and test foods) at 2 hour of blood glucose screen Poha Upma Besan paratha Besan cheela Raab Patoliya Gatte ki sabji Pittor ki sabji Papad ki sabji Badi ki sabji Kabuli Dal bati Mirchiwada Kachori Samosa Ref. food .025 .122 -.193 -.221 .315 -.024 .018 .307 .322 .466 .582 -.565 -.403 .001 .205 Poha .306 .748 * .593 -.460 -.416 -.051 .144 -.115 -.027 -.476 -.514 .584 .559 .055 Upma .238 .165 -.796 ** -.189 .385 .300 -.674 -.287 -.027 -.194 .099 .666 * .396 Besan paratha .200 -.418 -.616 .296 .260 -.082 -.237 -.497 -.092 .783 ** .411 -.128 Besan cheela -.251 .440 -.287 -.130 -.099 .055 -.356 -.501 .014 .307 -.032 Raab .315 -.076 -.156 .585 .267 .424 .074 -.448 -.501 -.342 Patoliya -.372 -.200 .238 .321 .244 -.206 -.714 * -.380 -.054 Gatte ki sabji .471 -.361 -.411 -.055 .257 .168 .459 .046 Pittor ki sabji .098 .235 =.402 -.497 -.028 .129 .711 * Papad ki sabji .087 ** .163 -.323 -.186 -.740 * -.235 Badi ki sabji .149 -.630 -.446 -.660 * .148 Kabuli .143 -.479 -.209 -.406 Dal bati .268 -.057 -.495 Mirchiwada .449 -.263

Kachori .137 Samosa Significance at .01 level (**) High significance and negative correlation among raab and upma (-.796); Very high significance and positive correlation among badi ki sabji and papad ki sabji (.807) High significance and positive correlation among mirchiwada and besan parantha (.783) Significance at .05 level (*) High significance and positive correlation among besan parantha and poha (.748); High significance and negative correlation among mirchiwada and patoliya (-.714) High significance and positive correlation among kachori and upma (.666); High significance and negative correlation among kachori and papad ki sabji (-.740) High significance and negative correlation among kachori and badi ki sabji (-.660); High significance and positive correlation among samosa and pittor ki sabji (.711) Significance of degree of correlation ±.00 to ± .20 = Very Low ± .21 to ± .40 = Low ± .41 to ± .60 = Average ± .61 to ± .80 = High ± .81 to 1.00 = Very High

Chapter-5 CONCLUSION AND RECOMMENDATIONS

140 T Chapter – 5 CONCLUSION AND RECOMMENDATIONS he present study was carried out at THE ENDO CLINIC of Jodhpur city, Rajasthan to estimate glycemic index of local foods consumed by diabetic patients of Jodhpur city and its impact on their blood glucose level. Accordingly, a total 310 subjects were studied out of which 150 males and 150 females aged between 35-45 years were selected .The data includes general information on the basis of age, education, eating habits. The more emphasis was given over the consumption pattern of local foods on the basis of their daily meal pattern so as to list out the frequently consumed food items General information was collected on the basis of table no.4.1, 4.2 and 4.3 information regarding age, education and eating habits are shown in percentage with respective graphical representation. The results showedthat 41%

males and 24% females

of age.On the basis of percentagemean of subjects education, both the subjects were under the category of literate. None of them was under illiterate category.Percentage distribution on the basis of eating habits was calculated, where both the subjects were under vegetarian category. As per the need of the study, two different groups of subjects were selected .In the first part of study, the criteria was to collect information and data regarding food consumption pattern and frequency of local foods among diabetic subjects so that the pattern of consumption and most frequently consumed foods can be listed out. From the information collected by the diabetic subjects foods were categorized on the basis of food frequency questionnaire.

141 The second part of the study, 10 healthy and non -diabetic subjects were selected for testing the and estimating Glycemicindex of 15 highly consumed foods and on the basis of glucose readings glycemic index was calculated and foods were classified on the basis of classification table. The results and statistical analysis showed that all the foods were under the range of very high and moderately high GI list, which shows that higher the ranking of food's GI faster it will increase the glucose levels. The present study concludes that the local foods consumed by diabetic patients of jodhpur city are high in their Glycemic index ranking. As the results showed, higher The GI ,higher will be the incremental peak rise in blood sugar levels. When these foods will be consumed by type 2 diabetic patients, there will be risein their blood glucose level as high glycemic index and deficit in the insulin will show peak rise than the normal range. Therefore, diabetic patients consuming high GI foods will be at risk of abnormal rise in the blood sugar after consumption of these foods. Foods like besancheela, gatte, pittor, mirchiwadapoha ,upma have ranking of GI obove 100 on the scale(more than 100- very high) which is considered as very high in ranking. The results will be a helping tool in management of diabetes as by portion control ,intake pattern, reduction in frequency and by understanding the concept of glycemic index ,dabetes can be managed and correct dietary guidelines can help diabetics to select the food wisely.

Recommendations:- ❖ Further studies are needed to assess glycemic index of staplefoods among rural sections of community. ❖ Further research can be done on actions of glycemic index of ready to eat food (packed food) among Type 1 ,LADA and MODY diagnosed population. ❖ Further research can be done onestimating (Meal) glycemic index as it has become need of the present era to assess the glycemic index of complete meal. ❖ Further studies on coping strategies and implementation of glycemic index values in meal planning by the nutritionist can be a great step in managing diabetes. ❖ Further studies on reduction of glycemic index ranking of locally consumed foods by diabetic patients of Jodhpur can help in diabetes management and can delay the rise in blood glucose level.

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the management of diabetes mellitus, diet has been recognized as a cornerstone of the therapy. There is a considerable evidence to show that good control of blood glucose prevents or delay the debilitating complications of diabetes. The use of carbohydrate both in terms of quantity as well as quality in diabetes meal planning has always been a key therapeutic issue. The amount of total carbohydrate recommended for diabetic diet has varied significantly over the years.	the management of diabetes mellitus, diet has been recognized as a cornerstone of therapy. There is considerable evidence to show that better control of blood sugar prevents or delays the debilitating complications of diabetes 1 . The use of carbohydrate both in terms of quantity as well as quality in diabetic diet, has always been a key therapeutic issue 2 . The amount of total carbohydrate recommended for the diabetic diet has varied significantly over the years 3 .

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There are many traditional beliefs regarding the type of carbohydrate in the diabetic diet, which in	There are many traditional beliefs regarding the type of carbohydrate in the diabetic diet, which in

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recent years are questioned. According to traditional thoughts, simple sugars are rapidly digested and absorbed and therefore	recent years are questioned. According to traditional thought, simple sugars are rapidly digested and absorbed and therefore

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is defined as the area under the glucose response curve after consumption of 50 g carbohydrate from a test food	is defined as the area formed under the glycemic response curve, after the consumption of 50g of available carbohydrate from a test food,

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Many factors together, including carbohydrate type, fiber, protein, fat, food form and method of preparation, determine the GI of a particular food (

Many factors together, including carbohydrate type, fiber, protein, fat, food form and method of preparation, determine the GI of a particular food.

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Analysis of Data: Data was statistically analyzed as per the objectives of the study.

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Standard Deviation √ ∑( )= mean of observations N = number of observations 79 Standard Error √ σ, = standard deviation N = number of observation T – test

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were under the age group of 35-40 years whereas 52% males and 76% females were under the age group of 40-45 years

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Percentage distribution of subjects on the basis of Education 100 90 80 70 60 50 40 30 20 10 0 Literate IlliterateMalesubjectsFemalesubjectsPercentage85 Table 4.3 Percentage distribution of subjects on the basis of

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Twice a week 32.66 20

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Male (n=150) % Female (n=150) % Once a week 36 44.66
Twice a week 30.66 22.66

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10/24	SUBMITTED TEXT	27 WORDS	62% MATCHING TEXT	27 WORDS

frequency - Patoliya 40 35 30 25 20 15 10 5 0 Male
(n=150) Females (n=150) Once a week Twice a week On
week Monthly Rarely

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11/24	SUBMITTED TEXT	17 WORDS	100% MATCHING TEXT	17 WORDS

Male (n=150) % Female (n=150) % Once a week 25.33
29.33 Twice a week 27.33 33.33

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Male (n=150) Female (n=150) Once a Twice a On week
Monthly Rarely

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13/24	SUBMITTED TEXT	17 WORDS	100% MATCHING TEXT	17 WORDS

Male (n=150) % Female (n=150) % Once a week 36 32.66
Twice a week 25.33 24.66

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14/24	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

Male (n=150) % Female (n=150) % Once a week 48.66 40.66 Twice a week 26 22

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16/24	SUBMITTED TEXT	17 WORDS	100% MATCHING TEXT	17 WORDS

Male (n=150) % Female (n=150) % Once a week 46 34.66 Twice a week 22.66 11.33

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17/24	SUBMITTED TEXT	15 WORDS	78% MATCHING TEXT	15 WORDS

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Male (n=150) % Female (n=150) % Once a week 12 14 Twice a week 8.99 6.66

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19/24	SUBMITTED TEXT	17 WORDS	78% MATCHING TEXT	17 WORDS

Male (n=150) Female (n=150) 10 0 Once a week Twice a week On week Monthly Rarely

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21/24	SUBMITTED TEXT	18 WORDS	100% MATCHING TEXT	18 WORDS

Male (n=150) % Female (n=150) % Once a week 32.66 37.33 Twice a week 8.99 12

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20/24	SUBMITTED TEXT	18 WORDS	78% MATCHING TEXT	18 WORDS

Male (n=150) Female (n=150) 10 0 Once a week Twice a week On week Monthly Rarely

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subjects who were willing to participate in the study were

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were under the age group of 35-40 years whereas 52% males and 76% females were under the age group of 40-45 years

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FACULTY OF SCIENCE

CERTIFICATE

Date : 8/10/2013 No. 10

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_____ in the Department of Home Science

Jai Narain Vyas University, Jodhpur has qualified the course work organized by the university during Session 2013-14.

This Certificate is issued in accordance with the provisions of UGC (Minimum Standards and Procedure for Award of M.Phil/Ph.D. Degree) Regulations 2009 notified in the Gazette of India on 11th July 2009.

Professor & Head
Department of Home Science
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Jodhpur

HEAD

Dean
Faculty of Science
J.N.V. University
JODHPUR

DEAN

PRE Ph.D PRESENTATION CERTIFICATE

Prof. Ashok Purohit
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No. J.N.N.U. /Sc. /P.G. /H. Sc. /19/ 3449

Date 24/10/2019

TO WHOM IT MY CONCERN

This is to certify that Ms. Khushboo Vyas, Research Scholar of the Department of Home Science, J. N. V. University, Jodhpur has delivered her **Pre. Ph. D Presentation** on the topic **"ESTIMATION OF GLYCEMIC INDEX OF LOCAL FOODS CONSUMED BY DIABETIC PATIENTS OF JODHPUR CITY AND ITS IMPACT ON THEIR BLOOD GLUCOSE LEVEL"** in the Department of Home Science on 24th Oct. 2019. Her presentation was satisfactory at 11.30 P. M.

Dr. Ashok Purohit
Professor & Head

Professor & Head
Department of Home Science
Jai Narain Vyas University
Jodhpur

Dr. Raka Srivastava
Retd. Associate Professor
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Faculty of Science
Jai Narain Vyas University,
Jodhpur (Raj.) – 342011

CERTIFICATE OF PLAGIARISM CHECK

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Course Of Study	Doctor of Philosphy (Ph.D)
Title Of Thesis	ESTIMATION OF GLYCEMIC INDEX OF LOCAL FOODS CONSUMED BY DIABETIC PATIENTS OF JODHPUR CITY AND ITS IMPACT ON THEIR BLOOD GLUCOSE LEVEL
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Chapter-1 Introduction

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the management of diabetes mellitus, diet has been recognized as a cornerstone of the therapy. There is a considerable evidence to show that good control of blood glucose prevents or delay the debilitating complications of diabetes. The use of carbohydrate both in terms of quantity as well as quality in diabetes meal planning has always been a key therapeutic issue. The amount of total carbohydrate recommended for diabetic diet has varied significantly over the years.

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There are many traditional beliefs regarding the type of carbohydrate in the diabetic diet, which in

the

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recent years are questioned. According to traditional thoughts, simple sugars are rapidly digested and absorbed and therefore

people suffering from diabetes mellitus should restrict the amount and preparations containing simple sugars.` Blood glucose levels are raised after food containing carbohydrates (sugars and starch) are eaten. Different rank of carbohydrate counting also affects the blood glucose levels differently. GLYCEMIC INDEX:- The glycemic index (GI) is a relative ranking of carbohydrate in foods according to how they affect the blood glucose levels. Carbohydrates with low GI value are more slowly digested, absorbed and metabolized and cause a lower and slower rise

14 in blood glucose and therefore affects the need and action of insulin uptake by the body. The concept of glycemic index (GI) was proposed by Jenkins and colleagues in 1981 to characterize the rate of carbohydrate absorption after a meal (Jenkins et al. 1981).

GI

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is defined as the area under the glucose response curve after consumption of 50 g carbohydrate from a test food

divided by the area under the curve after consumption of 50 g carbohydrate from a control food, either white bread or glucose (Wolever et al. 1991). Over the past two decades, the GI of most commonly consumed carbohydrate-containing foods has been measured (Foster- Powell and Miller 1995).

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Many factors together, including carbohydrate type, fiber, protein, fat, food form and method of preparation, determine the GI of a particular food (

Bjorck et al. 1994, Estrich et al. 1967, Welch et al. 1987, Wolever et al. 1991). Professor David J.A. Jenkins who is a British born university professor in the department of nutritional sciences at the University of Toronto, Canadain the year 1981 is credited with developing the concept of glycemic index as a way of explaining the way in which dietary carbohydrate impacts the blood sugar. His first paper on subject appeared in the American Journal of Clinical Nutrition in 1981.

According to Jenkins, Diabetes mellitus has various types: Type 1, Type 2, Gestational diabetes mellitus and others such as Maturity onset diabetes in the young (MODY), Latent autoimmune diabetes of adulthood (LADA), What all these disorders have in common is an inherent inability to self- regulate the levels of blood glucose or cellular fuel in the body. Type 2 diabetes, the most common type of diabetes, is also one of the most prevalent chronic disease around. Worldwide, more than 150 million people suffer from the disease; the international diabetes federation projects that this population will double globally by the year 2025, while excess body weight is a major risk

15 factor for type 2 diabetes, ethnic background, family history and certain components of your health profile also play an important role. Type 2 diabetes is not caused by absence of hormone insulin, as in case with type 1 diabetes but it is rather caused by body's inability to use insulin properly. People with type 2 diabetes have a condition called insulin resistance. They can produce insulin, usually in sufficient amount at first ,but it doesn't bind properly to the insulin receptor that is the gateway to cell in muscle, fat, liver tissue and therefore, resistant to its effects. As a result, glucose doesn't enter the cells and instead . The second condition that sets the stage for type 2 diabetes is insulin deficiency- the pancreas also has difficulty producing sufficient amount of insulin to process the rising blood glucose levels. Eventually, it does not have sufficient amounts to overcome the deficit. The toxic effects of long term high glucose levels on the insulin producing beta cells on the pancreas (glucotoxicity) can make insulin deficiency worse. Type 2 diabetes does not strike without warning. Pre-diabetes, also known as impaired glucose tolerance (IGT) or impaired fasting glucose(IFG) precedes the condition by months, years and sometimes by decades. As the name suggests, pre-diabetes is defined by blood glucose levels that are higher than normal but not as high enough to indicate diabetes. The actual clinical criteria for diagnosis of pre diabetes is blood glucose level of 110 to 125 mg/dL as determine by fasting blood glucose test and post prandial (2 hours after meal) rising is to 140- 199mg/dL.(ADA) Pre diabetes is a signal that if lifestyle changes and correction in eating pattern is not done, you are most likely to on the path of full-fledged type 2 diabetes. And having pre-diabetes is a danger in itself. It increases the chances of stroke and heart disease by 50% and may also be associated with an increased risk of colon cancer.

16 According to ADA (American Diabetes Association) one of the reason for the boom in type 2 diabetes is the widening of waistbands and the trend towards a more sedentary lifestyle in developed and developing countries .Increasing cases of obesity and wrong eating habits ,more interest of consuming packed and processed food are also contributing in worsening the condition by 40% and obesity and newly diagnosed cases are increasing rapidly. The progression of type 2 diabetes is associated with risk factors which are : Age and ethinicity:- According to American Diabetes Association, over half of all cases in people over age fifty five and older suffer from type 2 diabetes. Therefore, Individuals over the age of forty five should be tested for diabetes and retested every three years thereafter if the initial test is normal. Family history:- Heridity plays a very important role in development of type 2 diabetes. If you have first degree relative (strong genetic/family) history, chances of developing the disease and its risk doubles. Hypertension and cholesterol levels: Hypertension or blood pressure higher than 140/90 mmHg, is both a possible complication of type 2 diabetes and a risk factor for the development of disease. A large scale of over 12,000 patients published in the New Journal Of Medicine in the year 2000 found that people with diagnosed hypertension were 2.5% most likely to develop type 2 diabetes than those with normal blood pressure and the study also shows the correlation between the beta blockers(a medication used to treat high blood pressure) and an increased risk of type 2 diabetes. Triglyceride

17 levels over 250mg/dL and levels of HDL or (good cholesterol) under 35 mg/dL put you on the risk of type 2 diabetes. Risk associated with weight and BMI:- The ADA suggested that obesity has been on steady rise over the past few decades, with nearly one- third of all adults over the age group of twenty are classified as obese, according to the 1999-2000 National Health And Nutrition Examination Survey (NHANES) Being overweight or obese is a primary risk factor for developing pre diabetes and type 2 diabetes. The U.S Department of Health And Human Services (HHS) reports that over 80% of people with type 2 diabetes are clinically obese. Too much fat makes it difficult for the body to use its own insulin to process blood glucose and bring it to down to normal circulating levels. BMI stands for body mass index- a number to express weight in relationship to height and it is a reliable indicator of overall body fat. People with BMI of 25 to 29.9 are considered overweight. Further obesity is classified on the basis of BMI grading. Extreme obesity is classified as BMI 40 or above 40. The NIDDK (National Institute Of Diabetes And Digestive And Kidney Disease) reports that 67 % of people with type 2 diabetes have a BMI of 27 and above and 46% have a BMI of 30 or higher. BMI range between 18.5 to 24.9 is considered to be normal. The four main reasons are :- 1. Overweight people have fewer available insulin receptors 2. More fat requires more insulin 3. Excess fat promotes further insulin resistance. 4. Fat cells release free fatty acids (FFAs)

18 As discovered by Rockefeller university researcher in 1995, leptin (a hormone in fat cells that helps to metabolize fatty acids) also plays an important role in sending a satiety or full signal to brain to stop eating when body fat increases and an empty signal when body fat is insufficient. The United Nations FAO/WHO has suggested the consumption of healthy diet

as a management and prevention strategy for these diseases and recommends the use of glycaemic index (GI) of food along with information related to food composition so that people can make better food choices (FAO/WHO, 1998, 2015). Foods with high GI are not only responsible for insulin related complications and high lipid concentrations but are also evidenced to be a risk factor for obesity (Schwingshackl and Hoffmann, 2013), depression in women (Gangwisch et al., 2015) and metabolic syndrome which is characterized by abdominal obesity, hyperlipidemia, hypercholesterolemia, hypertension and high fasting blood glucose levels (Song et al., 2014) The criteria of selecting the topic is very significant as diabetes mellitus gets directly affected by quantity and quality of carbohydrate consumed. Diet plays a very significant role in managing diabetes and therefore, ADA (American Diabetes Association)refers to dietary management of diabetes as “MEDICAL NUTRITION THERAPY” (MNT).The food we eat has direct impact on our blood glucose levels and therefore also on diabetes control and its related riskand complications. All about Carbohydrates:- The body began to convert carbohydrate almost entirely into glucose shortly after carb containing foods are eaten. .If there is inadequate or insufficient insulin to help process this glucose into cellular fuel, consuming too many carbohydrate can cause blood glucose to rise to dangerous levels. Without carbohydrate generated glucose you could not function, yet too much can cause irreparable damage.

19 All foods that contain starches/ sugars- including fruits, vegetables, milk, breads, grains, beans, pasta. To avoid carbohydrate containing foods is both impossible and unadvisable- our body needs the important micro nutrient and phytochemicals present in these foods, In fact, WHO recommends that carbohydrate from a variety of foods account for 55 % of total calories in our daily diet. Does it matter what kind of carbohydrate we consume? At one time nutritionist believed that people with diabetes should avoid simple sugars (mono and disaccharides) and eat food containing complex carbohydrate, instead with the mistaken belief that simple sugars would raise glucose levels faster and more dramatically. But now its known that gram for gram, complex carbohydrates found in bread, cereals, potatoes, vegetables, roots and tubers and other food raises the blood sugar approximately the same amount as simple sugar like honey, fructose or table sugar. However, there may be a difference in how rapidly certain foods raise sugar levels. The Glycemic index or GI is a measure of how quickly the carbs in certain foods are digested and transformed into blood glucose. When we talk about diet management in diabetes, the first and foremost thing comes to our mind is climatic conditions, locally grown foods according to type of soil, system and interest developed in eating practices from generations, belief systems, physical activity, eating frequency, type of food, eating habits, local availability ,income group and regional values and culture. As we know there is a trend of consumption of calorie rich diet in western belt of Rajasthan specifically jodhpur and the number of cases of diabetes are increasing rapidly, evaluation of glycemic index of local foods and most frequently consumed

20 foods on regular basis will act as a guideline to make correct food choices both in quality and quantity. The GI of foods does not necessarily correspond to specific carbohydrate “type” – some complex carbohydrate may have higher GI than simple carbohydrate. For people of jodhpur city diagnosed with type 2 diabetes and pre diabetes, the Glycemic index can be an effective tool for avoiding blood sugar spikes. Importance of counselling in management of diabetes: Atherapeutic diet plays an important role in the treatment of diabetes. The diet may be used alone or in combination with insulin or oral hypoglycemic drugs. The diet counselling includes following important parameters :- • Type of carbohydrate • Cooking methods • Portion size • Frequency of meals. • Local availability. • Likes dislikes • Use of fiber in decreasing the later effects of calorie rich food. • Distribution of carbohydrates in every meal. • Including fibre in diet • Combination meals • Stage of diabetes with reference to absence or presence of any other complication.

21 OBJECTIVES:- The study was conducted to determine four important components:- 1. To study the consumption pattern of local foods among the people of Jodhpur city diagnosed with type 2 diabetes mellitus. 2. To list out most commonly consumed local foods by the selected subjects of Jodhpur city. 3. To estimate the Glycemic index of frequently consumed food items. 4. To provide suggestive guideline for making correct choices and portion control in meals to have better diabetes management. (Educational workshop by lecture method)

Chapter-3 METHODOLOGY

56 Chapter – 3 METHODOLOGY he present study was conducted to estimate the glycemic index of local foods consumed by diabetic patients of jodhpur city and its impact on their blood glucose level. Details of the methodology followed for the study have been described below: Locale The study was conducted in Jodhpur city of Rajasthan.. The samples were obtained by —THE ENDO CLINIC‖ – a clinic at Jodhpur city run by a renowned endocrinologist. Sample selection: The entire sample was selected from THE ENDO CLINIC as it has nearly eighty percent of daily OPD of patients from middle to higher income group diagnosed with diabetes mellitus. Therefore, subjects were purposively selected

from this clinic to get the reliable data which justifies the topic of the above study. Sample size: A sample size of total 310 subjects were selected through scattered purposive sampling technique. Subjects were selected using following criteria: T

57 For collecting data on frequent consumption of local food items in their daily meals:- 1. 300 subjects (150 males and 150 females) 2. Age between 35 -45 years. 3. Subjects who were diagnosed with type 2 diabetes mellitus. 4. Willingness to participate in the study. For estimation of glycemic index of listed testing food and reference food. 1. 10 subjects (5 males and 5 females) 2. Age between 30 -40 years. 3. Subjects with normoglycemia (non diabetic)/ normal blood glucose level. 4. Willingness to participate. TOOLS Tools were designed to collect required information from the subjects as per the need of the study. Data collection An interview schedule was developed to obtain the desired information from the subjects, which included :- 1. Socio demographic profile:- This includes the general information about the subjects regarding their age, education andfood habits. 2. 24 hour dietary recall method:- A 24 hour dietary recall (self-administered) questionnaire was developed as per FAO (2018) guidelines in which detail information about the quantity,

58 frequency, intake pattern of foods consumed throughout the day were listed and recorded. 3. Food frequency questionnaire:- Food frequency questionnaire performa (Appendix) was developed to obtain frequently consumed food items in a day ,week or a month. FOOD FREQUENCY TABLE Food items Once a week Twice a week On weekends Once in a month Rarely Poha Upma Besan Paratha Besan cheela Raab Patoliya Gatte ki sabji Pittor ki sabji Papad ki sabji Bdi ki sabji Kabuli Dal Bati Mirchiwada Kachori Samosa

59 PLATE – 1 Plate showing test foods Poha and Upma

60 PLATE – 2 Test food besan paratha and besan cheela

61 PLATE – 3 Test food raab and patoliya

62 PLATE – 4 Test food gatte and pittor ki sabji

63 PLATE – 5 Test food papad and badi ki sabji

64 PLATE – 6 Test food kabuli and dal bati

65 PLATE – 7 Test food mirchiwada, kachori and samosa

66 Tools used for the estimation of glycemic index of listed foods:- Glycemic index formula given by Jenkins et.at 1981 was used in the study. Where, IAUC is incremental area under curve. Test food is 50 g digestible carbohydrate from test food. Reference food is 50 g glucose. (For reference food, 50g of dextrose (Glucon−D glucose powder, Heinz India (P) Ltd., Mumbai, India) was dissolved in 200 ml of water and was given to subjects.) To calculate the incremental area under curve IAUC, a mathematical rule called trapezoid rule is used for calculation of IAUC. TRAPEZOID RULE IS CALCULATED BY USING THE FORMULA GIVEN BELOW :- ½ × (SUM OF PARELLEL LINES) × WIDTH OGTT(Oral Glucose Tolerence Test)Tool: OGTT was performed by using pre calibrated automatic lancet device-SD Code free blood glucose meter, produced by SD Biosensor , a diagnostic company from South Korea. This meter is used in the recording of sample as it meets the 2013 ISO standards for blood glucose meter accuracy. Fating state blood samples were taken by finger pricked capillary method at zero minute which was taken as baseline. The subjects were then asked to consume the reference / test food. Time was noted and further blood samples were obtained at 0 hour, 1 hour and 2 hour time frame.

67 The blood glucose respone curves were plotted for the reference and test foods. Further IAUC (incremental area under curve) were calculated geometrically using the trapezoid rule (FAO/WHO 1995). PLATE – 8 Plate showing reference food glucose

68 PLATE – 9 Electronic glucometer used for capillary blood test

69 PLATE – 10 Finger pricking and sample collection and Glucometer reading

70 FLOWCHART OF THE STEPS FOLLOWED FOR THE REFERENCE AND TEST FOOD CONSUMPTION. CONSUMPTION OF REFERENCE FOOD AND BLOOD SUGAR RESPONSE MEASURED ↓ After 2 days CONSUMPTION OF TEST FOOD 1 AND BLOOD SUGAR RESPONSE MEASURED ↓ After 2 days CONSUMPTION OF TEST FOOD 2 AND BLOOD SUGAR RESPONSE WAS MEASURED ↓ After 2 days CONSUMPTION OF n…..TEST FOODS AND BLOOD SUGAR RESPONSE WAS MEASURED TABLE SHOWING INGREDIENTS OF TEST FOOD Poha Weight (g) Carbohydrate (g) Poha 60 46.38 Tomato 20 0.72 Peanuts 10 2.67 Oil 10 0 Upma Weight (g) Carbohydrate (g) Semolina 65 48.62 Tomato 20 0.72 Onion 10 2.52 Ghee 10 0

71 Besan paratha Weight (g) Carbohydrate (g) Gram flour 20 12.18 Wheat flour 55 38.17 Oil 10 0 Besan cheela Weight (g) Carbohydrate (g) Gram flour 80 48.72 Green chilli 5 0.45 Coriander 5 0.31 Oil 10 0 Raab Weight (g) Carbohydrate (g) Bajra

flour 72 48.6 Buttermilk 250ml 1.2 Patoliya Weight (g) Carbohydrate (g) Bajra flour 75 50.06 Ghee 15 0 Gatte ki sabji Weight (g) Carbohydrate (g) Gram flour 80 48.72 Curd 50 1.5 Oil 15 0 Pittor ki sabji Weight (g) Carbohydrate (g) Gram flour 80 48.72 Curd 50 1.5 Oil 15 0 Papad ki sabji Weight (g) Carbohydrate (g) Urad dal(2 papads) 80 50.08 Oil 10 0

72 Badi ki sabji Weight (g) Carbohydrate (g) Moong dal(10 small nuggets) 88 49.8 Oil 10 0 Khichdi (kabuli) Weight (g) Carbohydrate (g) Rice 45 35.1 Bread(1/2 slice) 10 5.1 Cashew 10 2.23 Ghee 15 0 Gatte 10 6.9 Paneer 10 0.24 Dal bati Weight (g) Carbohydrate (g) Dal 25 14.9 Bati 50 34.7 Ghee 10 0 Mirchiwada Weight (g) Carbohydrate (g) Gram flour 75 45.67 Potato 20 4.52 Oil 60 0 Green chilli 5 0.45 Kachori Weight (g) Carbohydrate (g) Refined flour 55 40.6 Mogar dal 15 9.01 Oil 50 0 Samosa Weight (g) Carbohydrate (g) Refined flour 60 44.3 Cashew 10 2.23 Potato 20 4.52 Oil 60 0

73 Coping Tool: Group Counselling through lecture method: On the basis of research findings, a coping tool was developed in which all the selected diabetic subjects who participated in the study were called and through lecture method and on the basis of medical nutrition therapy given by American Diabetes Association, group counselling was conducted to educate subjects about understanding carbohydrate quality and quantity, its effects after digestion, knowing the portion size, understanding immediate and delayed blood glucose response, understanding importance of right selection of food and making correct choices, understanding non - scientific myths regarding specific food consumption at regional level and above all, most importantly understanding the response of local foods available and prepared at home and its effects on their blood glucose levels thus resulting in making wise choices while selecting and making food choices for their daily plate of meal. Counselling points included :- ➢ Type of carbohydrate. ➢ Amount of fibre ➢ Type of preparation ➢ Cooking methods ➢ Importance of fibre in meal was discussed as itincreases theintestinal transmit time, delays gastric emptying and slows down glucose absorbtion. ➢ Refined foods like sooji, maida should be avoided as they are low in fibre and hence increases faster breakdown of sugars and starches resulting in high glucose levels. ➢ Smaller the particle size, more is the glycemic effect.

74 ➢ Raw foods having larger particles, therefore have a lower effect than cooked homogenized foods. ➢ Foods cooked by dry and short time methods like roasting have a lesser glycemic effects as compared to foods cooked by boiling and long coking process which reduce particle size. ➢ Preparations like roasted chana, chapatis, sprouts and whole fruits are more suitable than khichri or boiled rice. ➢ Misconceptions regarding gram flour(as its said besan reduces blood glucose level post meal) was proved wrong in the above study as test foods like mirchiwada and besan cheela are high in G.I. whereas besan parantha which has mixed grain was comparatively less on G.I. scale in the result.

75 PLATE – 11 Counselling session 1

76 PLATE – 12 Counselling session 2

77 PLATE – 13 Counselling session 3

78

Percent was used for presenting information regarding background. Mean values were calculated for the data obtained from food frequency questionnaire as to assess the frequency of consumption of local food pattern . T – test for difference between two means was applied for assessing the difference between reference food and test food . Coefficient of correlation was used to find out relationship between reference food and test food. Formulas used for analysis of data are given below (Gupta, 1992) Mean = ∑ ∑X= Sum of all the observation values N= Total number of items

for difference between two means: In experimental work, generally it becomes necessary to test whether two samples differ from one other significantly in their means or whether they may be regarded as belonging to same population. ( ) √ ( ) ( ) x 1 = mean of reference food x 2 = mean of test food S 1 = standard deviation of reference food S 2 = standard deviation of test food n = number of items Coefficient of correlation When two variables cannot be considering the light

of dependence , and independence , in such cases with fair certainty that there is a relation of some sort and the type of relation is to be estimated along with the extent of two variables varying together sand influencing each other, coefficient of correlation is used . A measure of the degree of the relationship between the two variables which may be independent of any particular unit is needed . Karl Pearson developed such a

80 coefficient which may measure the degree of relationship or association This coefficient is Coefficient of Correlation and is denoted by r, its formula is given as under— (∑) (∑)(∑) √[∑ (∑)][∑ (∑)] r = coefficient of correlation n = number of subjects x and y are the obtained raw scores of the subjects respectively.

Chapter-4 RESULTS AND DISCUSSION

82 Chapter – 4 RESULTS AND DISCUSSION The present study was carried out at THE ENDO CLINIC of Jodhpur city, Rajasthan to estimate glycemic index of local foods consumed by diabetic patients of jodhpur city and its impact on their blood glucose level. Accordingly, a total 310 subjects were studied out of which 150 males and 150 females aged between 35-45 years were selected. The data includes general information on the basis of age, education, eating habits. The more emphasis was given over the consumption pattern of local foods on the basis of their daily meal pattern so as to list out the frequently consumed food items. General information:- On the basis of table no.4.1, 4.2 and 4.3 information regarding age, education and eating habits are shown in percentage with respective graphical representation. Percentage distribution of foods on the basis of their consumption frequency (Table 4.4 –Table 4.18) The first part of the study included 300 samples. Out of which 150 males and 150 females aged 35-45 years. On the basis of food frequency questionnaire and 24 hour dietary recall questionnaire.

83 Table 4.1 Percentage distribution of subjects as per age. Age Male subjects (n = 150) (In %) Female subjects (n = 150) (In %) Age 35=40 years 41.33 24 Age 40-45 years 52 76 Table 4.1 shows those 41%

males and 24% females

62%	MATCHING BLOCK 7/24	SA	C VD Methodology and Results Discussion.docx (D30208825)

were under the age group of 35-40 years whereas 52% males and 76% females were under the age group of 40- 45 years

of age. Percentage distribution of subjects as per age 80 70 60 50 40 Age 35=40 years Age 40-45 years 30 20 10 0 Male subjects Female subjects Percentage

84 Table 4.2 Percentage distribution of subjects on the basis of education. Education Male subjects (n = 150) In % Female subjects (n=150) In % Literate 100 100 Illiterate 0 0 Table no. 4.2 shows percentage mean of subjects on the basis of education. the table shows that both the subjects were under the category of literate. None of them was under illiterate category.

52%	MATCHING BLOCK 8/24	SA	Vaishya.R.D(18FSN22)MSc Thesis (1) (3).pdf (D77694297)

Percentage distribution of subjects on the basis of Education 100 90 80 70 60 50 40 30 20 10 0 Literate Illiterate Male subjects Female subjects Percentage 85 Table 4.3 Percentage distribution of subjects on the basis of

eating habits. Eating habits Male subjects (n=150) In % Female subjects (n=150) In % Vegetarian 100 100 Non vegetarian 0 0 Table 4.3 shows percentage distribution on the basis of eating habits, where both the subjects were under vegetarian category. Eating Habits 100 90 80 70 60 50 40 30 20 10 0 Vegetarian Non vegetarian Male subjects Female subjects Percentage

86 Table 4.4 Percentage distribution of subjects on the basis of consumption frequency of breakfast items listed below: Breakfast item Poha Male subjects (n=150) In % Female subjects (n=150) In % Once a week 42 46 Twice a week 32 27.33 On week ends 20 16 Monthly once 12 6.66 Rarely 10.66 4 Table 4.4 showed that the maximum in take frequency was once a week where in males it was 42% and in female subjects it was 46% respectively. Consumption frequency - Poha 50 45 40 35 30 25 20 15 10 5 0 Male subjects Female subjects Once a week Twice a week On week Monthly Rarely ends once Percentage

87 Table 4.5 Breakfast item Upma

100% MATCHING BLOCK 9/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n= 150) % Once a week 40 25.33 Twice a week 32.66 20

On week ends 15.33 30 Monthly once 8 21.33 Rarely 4 3.33 Table no. 4.5 of test food UPMA showed maximum intake frequency of once a week which in males was observed 40% whereas in females frequency was on weekends which was observed 30%. Consumption Frequency - Upma 40 35 30 25 20 15 10 5 0 Series1 Series2 Once a Twice a On week week week ends Monthly once Rarely Percentage

88 Table 4.6 Breakfast item Besan parantha Male (n=150) % Females (n=150) % Once a week 37.33 34 Twice a week 28 25.33 On week ends 18 18 Monthly once 12.66 16.66 Rarely 4 6 Table 4.6 of test food BESAN PARANTHA showed maximum intake once a week in males and females where in males it was observed 37.33% and in females it showed 34%. Consumption frequency - Besan Parantha 40 35 30 25 20 15 10 5 0 Male (n=150) Females (n=150) Once a week Twice a week On week Monthly Rarely ends once Percentage

89 Table 4.7 Breakfast items Besan cheela Male (n =150) % Females (n=150) % Once a week 32 35.33 Twicea week 22.66 24.66 On week ends 21.33 14.66 Monthly once 18.66 18.66 Rarely 5.33 6.66 Table 4.7 of test food BESAN CHEELA showed maximum intake frequency of once a week in both subjects, in males it observed 32% and in females it was 35.33%. Consumption frequency - Besan Cheela 40 35 30 25 20 15 10 5 0 Male (n =150) Females (n=150) Once a week Twicea week On week Monthly Rarely ends once Percentage

90 Table 4.8 Breakfast item Raab

100% MATCHING BLOCK 12/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 36 44.66 Twice a week 30.66 22.66

On week ends 15.33 8.99 Monthly once 26.66 20.66 Table 4.8 of test food RAAB showed maximum intake frequency of once a week in both the subjects, in males mean percentage was observed 36% and among females it was 44.66%. Consumption frequency - Raab 45 40 35 30 25 20 15 10 5 0 Male (n=150) Female (n=150) Once a week Twice a On week Monthly week ends once Percentage

91 Table 4.9 Breakfast item Patoliya Male (n=150) % Females (n=150) % Once a week 38 32.66 Twice a week 19.33 24.66 On week ends 20 17.33 Monthly once 22.66 16.06 Rarely 16.66 14.66 Table 4.9 of test food PATOLIYA showed maximum intake frequency of once a week in both the subjects, in males it was observed 38% and in females it was 32.66%. Consumption

62% MATCHING BLOCK 10/24 SA Sona thesis.doc (D21444835)

frequency - Patoliya 40 35 30 25 20 15 10 5 0 Male (n=150) Females (n=150) Once a week Twice a week On week Monthly Rarely

ends once Percentage

92 Table 4.10 Percentage distribution of subjects on the basis of frequently consumption of local vegetables / homemade recipes in lunch. Local vegetables consumed in lunch Gatte ki sabji

100% MATCHING BLOCK 11/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 25.33 29.33 Twice a week 27.33 33.33

On week ends 42.66 25.33 Monthly once 16 24.66 Rarely 2.66 4 Table 4.10 of test food GATTE KI SABJI it was observed that in male subjects maximum intake is on weekends which was observed 42.66% and among females maximum intake was twice a week which showed 33.33%. Consumption frequency Gatte ki Sabji 45 40 35 30 25 20 15 10 5 0

83% MATCHING BLOCK 15/24 SA Sona thesis.doc (D21444835)

Male (n=150) Female (n=150) Once a Twice a On week Monthly Rarely

week week ends once Percentage

93 Table 4.11 Local veg consumed in lunch Pittor ki sabji

100% MATCHING BLOCK 13/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 36 32.66 Twice a week 25.33 24.66

On week ends 20 19.33 Monthly once 27.33 26.66 Rarely 8 13.33 Table 4.11 of test food PITTOR KI SABJI showed maximum intake frequency of once a week in both the subjects where in males it was observed 36% and females it was 32.66%. Consumption frequency Pittor Sabji 40 35 30 25 20 15 10 5 Male (n=150) Female (n=150) 0 Once a Twice a On week week week ends Monthly once Rarely Percentage

94 Table 4.12 Local vegetables consumed in lunch Badi (Moong dal nuggets) Male (n=150) % Females (n=150) % Once a week 44.66 58.66 Twice a week 12.66 25.33 On weekends 22 12 Monthly once 32.66 16.66 Rarely 4.66 4 Table 4.12 of test food MOONG DAL BADI showed maximum intake frequency of once a week in both the subjects, in males the mean observed was 44.66% and in females it was 58.66%. Consumption frequency - Badi (Moong Dal Nuggets) 60 50 40 30 20 Male (n=150) Females (n=150) 10 0 Once a week Twice a On Monthly Rarely week weekends once Percentage

95 Table 4.13 Local veg consumed in lunch Papad ki sabji

100% MATCHING BLOCK 14/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 48.66 40.66 Twice a week 26 22

On week ends 12 16 Monthly once 20 21.33 Rarely 10 16.66 Table 4.13 of test food PAPAD KI SABJI showed maximum intake frequency of once a week in both subjects, in males it was observed 48.66% and in females it was observed 40.66%. Consumption frequency - Papad ki Sabji 50 45 40 35 30 25 20 15 10 5 0 Male (n=150) Female (n=150) Once a Twice a On week week week ends Monthly once Rarely Percentage

96 Table 4.14 Percentage distribution of subjects on the basis of frequently consumed local street snacks . Consumption pattern of Local street snacks Mirchiwada

100% MATCHING BLOCK 16/24 SA Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 46 34.66 Twice a week 22.66 11.33

On week ends 36 26.66 Monthly once 5.33 36 Rarely 6.66 8 Table 4.14 of test food MIRCHIWADA showed maximum intake frequency of once a week, in male sit was 46% wheras in female subjects it was 34.66%. Consumption frequency snacks - Mirchiwada 50 45 40 35 30 25 20 15 10 5 0

78% MATCHING BLOCK 17/24 SA Sona thesis.doc (D21444835)

Male (n=150) Female (n=150) Once a week Twice a week On week Monthly Rarely

ends once Percentage

97 Table 4.15 Consumption frequency of local street food Mogar kachori (small) Male (n=150) % Females (n=150) % Once a week 29.33 14 Twice a week 12 10.66 On week ends 36.66 40.66 Monthly once 30.66 45.33 Rarely 8 6 Table 4.15 of food MOGAR KACHORI showed maximum intake frequency in males was 36.66% (on week ends) wheras in females it was observed monyhly once at 45.33%. Consumption frequency snacks - Mogar Kachori Small 50 45 40 35 30 25 20 15 10 5 0 Male (n=150) Females (n=150) Once a week Twice a week On week Monthly Rarely ends once Percentage

98 Table4.16 Consumption frequency of local street foods Samosa (small)

100%	MATCHING BLOCK 18/24	SA	Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 12 14 Twice a week 8.99 6.66

On week ends 52.66 21.33 Monthly once 34 51.33 Rarely 9.33 23.33 Table 4.16 of food SAMOSA it showed on week ends frequency of 52.66% in males whereas monthly once frequency in females of 51.33% Consumption frequency snacks - Samosa Small 60 50 40 30 20

78%	MATCHING BLOCK 19/24	SA	Sona thesis.doc (D21444835)

Male (n=150) Female (n=150) 10 0 Once a week Twice a week On week Monthly Rarely

ends once Percentage

99 Table 4.17 Percentage distribution of subjects on the basis of consumption frequency of occasional local delicacies. Local occasional delicacies Khichdi (marwadi pulav with vegetables)

100%	MATCHING BLOCK 21/24	SA	Sona thesis.doc (D21444835)

Male (n=150) % Female (n=150) % Once a week 32.66 37.33 Twice a week 8.99 12

On week ends 30.66 44.66 Monthly once 39.33 20.66 Rarely 5.33 2 Table 4.17 of food KHICHDI showed intake frequency of monthly once in males with 39.33% whereas in female subjects it was onbserved 44.66% on week ends. Consumption frequency - Khichdi (Marwari Pulav with Vegetables) 50 40 30 20

78%	MATCHING BLOCK 20/24	SA	Sona thesis.doc (D21444835)

Male (n=150) Female (n=150) 10 0 Once a week Twice a week On week Monthly Rarely

ends once Percentage

100 Table 4.18 Local occasional delicacies Dal baati Males (n=150) % Females (n=150) % Once a week 25.33 26.66 Twice a week 10 8.99 On week ends 32.66 26 Monthly once 45.33 44 Rarely 3.33 11.33 Table 4.18 of food DAL- BAATI showed maximum intake frequency of monthly once in both the subjects where in males it showed 45.33% and in female subjects it was 44 respectively. Consumption Frequency - Daal Baati 50 45 40 35 30 25 20 15 10 5 0 Males (n=150) Females (n=150) Once a week Twice a week On week Monthly Rarely ends once Percentage

101 SECOND PART OF THE STUDY As the study was carried out to estimate the glycemic index of foods listed from food frequency method, ten

100%	MATCHING BLOCK 23/24	SA	Supriya v.docx (D93456152)

subjects who were willing to participate in the study were

selected with normoglycemia (normal blood glucose level) and who fall under normal category of BMI as per the guidelines given by WHO for the population living in Asia, BMI of 23 kg/m 2 indicated acceptable. Healthy volunteers between 30 to 40 years of age having BMI in between the range of 19.1 and 22.9kg/m 2 were selected. Subjects not lying in this category were excluded from the study. As to carry out the findings of study on 10 healthy subjects, BMI was calculated and all healthy individuals were falling under the range of 19 -24.9 which is considered as normal range of BMI (WHO, 2008).

102 Ref. Food Glucose(50g) 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Tables 4.19- 4.34 showing tabulation and graphical representation of blood glucose screening for all 15 selected test food and reference food(constant –glucose) at 0 hour, 1 hour, 2 hour and its incremental area under curve (IAUC) 50 g glucose o hour 1 hour 2 hour IAUC Subject 1 98

109 87 201 Subject 2 99 124 97 226 Subject 3 88 110 88 198 Subject 4 79 93 91 178 Subject 5 84 106 88 192 Subject 6 78 99 84 180 Subject7 80 112 108 206 Subject 8 103 120 111 227 Subject 9 90 106 101 201.5 Subject 10 91 103 97 197 Mean IAUC OF 50 G GLUCOSE C OF 50g GLUCOSE 200.6

103 Test food POHA 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC OF POHA o hour 1 hour 2 hour IAUC Table 4.20 for test food POHA POHA o hour 1 hour 2 hour IAUC Subject 1 86 116 140 229 Subject 2 80 104 125 206.5 Subject 3 94 112 110 214 Subject 4 99 120 126 232.5 Subject 5 89 97 117 200 Subject 6 91 103 106 201.5 Subject 7 98 110 107 212.5 Subject 8 93 120 126 229.5 Subject 9 89 113 121 218 Subject 10 100 119 130 234 MEAN IAUC OF POHA 217.75

104 Test food upma 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject7 Subject Subject Subject MEAN 1 2 3 4 5 6 8 9 10 IAUC OF UPMA o hour 1 hour 2 hour IAUC Table 4.21 for test food UPMA UPMA o hour 1 hour 2 hour IAUC Subject 1 78 130 110 224 Subject 2 88 121 106 218 Subject 3 80 102 98 191 Subject 4 84 94 96 184 Subject 5 92 106 97 200.5 Subject 6 96 116 110 219 Subject7 89 109 97 202 Subject 8 98 120 111 224 Subject 9 83 117 110 213.5 Subject 10 86 121 101 214.5 MEAN IAUC OF UPMA 209.05

105 Test food BESAN KA PARATHA 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Table 4.22 for test food BESAN KA PARATHA BESAN KA PARATHA o hour 1 hour 2 hour IAUC Subject 1 80 117 112 213 Subject 2 78 106 102 196 Subject 3 84 96 93 184.5 Subject 4 88 98 86 185 Subject 5 74 86 81 163.5 Subject 6 89 92 80 176.5 Subject 7 79 86 81 166 Subject 8 82 93 87 177.5 Subject 9 81 89 83 171 Subject 10 96 102 99 199.5 MEAN IAUC OF BESAN KA PARATHA 164.74

106 Test Food BESAN CHEELA 300 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR BESAN CHEELA o hour 1 hour 2 hour IAUC Table 4.23 for BESAN CHEELA BESAN CHEELA o hour 1 hour 2 hour IAUC Subject 1 89 133 120 237.5 Subject 2 88 124 109 222.5 Subject 3 94 119 106 219 Subject 4 91 124 118 228.5 Subject 5 87 130 121 234 Subject 6 89 128 116 230.5 Subject 7 96 118 104 218 Subject 8 81 129 120 229.5 Subject 9 79 113 110 207.5 Subject 10 100 131 124 243 MEAN IAUC FOR BESAN CHEELA 227

107 Table 4.24 for test food RAAB 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC OF RAAB o hour 1 hour 2 hour IAUC Table 4.24 for test food RAAB RAAB o hour 1 hour 2 hour IAUC Subject 1 78 84 81 163.5 Subject 2 88 92 91 181.5 Subject 3 90 96 94 188 Subject 4 96 99 93 193.5 Subject 5 100 105 98 204 Subject 6 80 86 85 168.5 Subject 7 98 106 101 205.5 Subject 8 90 98 92 189 Subject 9 79 88 83 169 Subject 10 83 96 91 183 MEAN IAUC OF RAAB 184.5

108 Test food PATOLIYA 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Table 4.25 for test food PATOLIYA PATOLIYA o hour 1 hour 2 hour IAUC Subject 1 80 87 84 169 Subject 2 72 88 83 165 Subject 3 81 94 88 178.5 Subject 4 86 91 89 178.5 Subject 5 97 100 94 195.5 Subject 6 93 99 95 193 Subject 7 89 93 90 182.5 Subject 8 84 94 92 182 Subject 9 81 89 87 173 Subject 10 97 100 94 195.5 MEAN IAUC OF PATOLIYA 181.2

109 Test food GATTE KI SABJI 300 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR GATTE KI SABJI o hour 1 hour 2 hour IAUC Table 4.26 for test food GATTE KI SABJI GATTE KI SABJI o hour 1 hour 2 hour IAUC Subject 1 88 133 122 238 Subject 2 86 137 119 239.5 Subject 3 79 129 117 227 Subject 4 84 109 105 203.5 Subject 5 96 119 110 222 Subject 6 89 124 116 226.5 Subject 7 87 130 116 231.5 Subject 8 99 128 120 237.5 Subject 9 98 117 105 218.5 Subject 10 84 109 101 201.5 MEAN IAUC FOR GATTE KI SABJI 224.5

110 Test food PITTOR KI SABJI 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IUAC FOR PITTOR KI SABJI o hour 1 hour 2 hour IAUC Table 4.27 for test food PITTOR KI SABJI PITTOR KI SABJI o hour 1 hour 2 hour IAUC Subject 1 87 128 122 232.5 Subject 2 83 111 107 206 Subject 3 94 120 108 221 Subject 4 89 116 104 212.5 Subject 5 93 119 107 219 Subject 6 91 113 110 213.5 Subject 7 97 127 121 236 Subject 8 89 126 113 227 Subject 9 81 119 111 215 Subject 10 79 114 110 224 MEAN IUAC FOR PITTOR KI SABJI 220.6

111 Test food PAPAD KI SABJI 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR PAPAD KI SABJI o hour 1 hour 2 hour IAUC Table 4.28 for test food PAPAD KI SABJI PAPAD KI SABJI o hour 1 hour 2 hour IAUC Subject 1 84 89 85 173.5 Subject 2 88 86 83 171.1 Subject 3 96 99 94 194 Subject 4 92 99 96 193 Subject 5 81 86 85 169 Subject 6 79 84 83 165 Subject 7 97 103 100 201.5 Subject 8 83 91 89 177 Subject 9 80 92 84 174 Subject 10 94 101 99 197.5 MEAN IAUC FOR PAPAD KI SABJI 181.46

112 Test food BADI KI SABJI 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR BADIKI SABJI o hour 1 hour 2 hour IAUC Table 4.29 for test food BADI KI SABJI BADI KI SABJI o hour 1 hour 2 hour IAUC Subject 1 81 85 84 167.5 Subject 2 79 83 80 162.5 Subject 3 80 89

83 170.5 Subject 4 90 96 94 188 Subject 5 75 81 80 158.5 Subject 6 82 88 86 172 Subject 7 90 98 96 191 Subject 8 87 96 89 184 Subject 9 79 87 86 169.5 Subject 10 89 98 94 189.5 MEAN IAUC FOR BADIKI SABJI 175.3

113 Test food KABULI 300 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR KABULI o hour 1 hour 2 hour IAUC Table 4.30 for test food KABULI KABULI o hour 1 hour 2 hour IAUC Subject 1 90 124 80 209 Subject 2 98 134 114 240 Subject 3 96 123 111 226.5 Subject 4 94 119 104 218 Subject 5 89 131 101 226 Subject 6 83 123 107 218 Subject 7 91 126 110 226.5 Subject 8 87 133 121 237 Subject 9 93 120 109 221 Subject 10 97 129 106 230.5 MEAN IAUC FOR KABULI 225.2

114 Test food DAL BATI 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR DAL BATI o hour 1 hour 2 hour IAUC Table 4.31 for test food DAL BATI DAL BATI o hour 1 hour 2 hour IAUC Subject 1 78 133 101 22.5 Subject 2 86 129 109 226.5 Subject 3 76 120 113 214.5 Subject 4 88 119 104 215 Subject 5 81 124 106 218 Subject 6 79 120 108 213.5 Subject 7 89 123 101 218 Subject 8 93 127 99 223 Subject 9 84 119 103 211.5 Subject 10 90 110 98 204 MEAN IAUC FOR DAL BATI 216.5

115 Test food MIRCHIWADA 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Table 4.32 for test food MIRCHIWADA MIRCHIWADA o hour 1 hour 2 hour IAUC Subject 1 86 104 117 205 Subject 2 90 116 109 215.5 Subject 3 96 126 114 231 Subject 4 89 109 106 206.5 Subject 5 93 107 101 204 Subject 6 88 99 96 191 Subject 7 86 101 94 191 Subject 8 92 107 100 203 Subject 9 97 119 106 220 Subject 10 88 119 104 214.5 MEAN IAUC FOR MIRCHIWADA 208.15

116 Test food KACHORI 250 200 150 100 50 0 o hour 1 hour 2 hour IAUC Table 4.33 for test food KACHORI KACHORI o hour 1 hour 2 hour IAUC Subject 1 94 123 127 233.5 Subject 2 91 118 121 224 Subject 3 98 116 113 221.5 Subject 4 89 120 109 219 Subject 5 97 124 120 232.5 Subject 6 86 119 112 218 Subject 7 94 108 104 207 Subject 8 98 118 126 230 Subject 9 100 126 120 236 Subject 10 93 113 109 214 MEAN IAUC FOR KACHORI 223.5

117 Test food SAMOSA 250 200 150 100 50 0 Subject Subject Subject Subject Subject Subject Subject Subject Subject Subject MEAN 1 2 3 4 5 6 7 8 9 10 IAUC FOR SAMOSA o hour 1 hour 2 hour IAUC Table 4.34 for test food SAMOSA SAMOSA o hour 1 hour 2 hour IAUC Subject 1 98 126 116 233 Subject 2 88 118 104 214 Subject 3 87 104 99 197 Subject 4 93 113 104 211 Subject 5 90 115 109 214 Subject 6 88 120 111 219.5 Subject 7 96 123 116 229 Subject 8 94 121 107 221.5 Subject 9 99 129 117 231 Subject 10 89 113 106 210 MEAN IAUC FOR SAMOSA 199.6

118 CALCULATED GLYCEMIC INDEX FOR 15 TEST FOOD TAKEN 250 200 150 100 50 0 Mean IAUC G.I. TABLE 4.35 SHOWING CALCULATED GLYCEMIC INDEX FOR 15 TEST FOOD TAKEN Ref. food Mean IAUC Ref. food 50 g Glucose 200.6 POHA 217.75 108.54 UPMA 209.05 104.21 BESAN KA PARATHA 164.74 82.12 BESAN KA CHEELA 227 113.1 RAAB 184.5 91 PATOLIYA 181.2 90.35 GATTE KI SABJI 224.5 111.9 PITTOR KI SABJI 220.6 109.9 PAPAD KI SABJI 181.4 90.4 BADI KI SABJI 175.3 87.3 KABULI 225.2 112.28 DAL BATI 216.6 108 MIRCHIWADA 208.15 103.7 KACHORI 223.5 111.4 SAMOSA 199.6 99.5

119 G.I CLASSIFICATION TABLE Classification of GI on the basis of result findings Reference : American Journal Of Clinical Nutrition (July 2002) High GI foods (Rank 100+) Moderately high GI foods (Rank 80-99) Low GI foods (Rank >80) POHA – 108.5 BESAN PARATHA – 82.12 UPMA – 104.2 SAMOSA – 99.5 KACHORI – 111.4 RAAB – 91 MIRCHIWADA – 103.7 BADI KI SABJI – 87.3 BESAN CHEELA – 113.1 PATOLIYA – 90.3 KHICHDI – 112.2 PAPAD KI SABJI – 90.4 PITTOR KI SABJI – 109.9 DAL BATI - 108 GATTE KI SABJI – 111.9

120 Statistical analysis Statistical analysis of selected test foods and calculation of t - test of food is given below:- Table 4.36- 4.51 showing t – TEST Calculations and results Table 4.36 The above table no. 4.36 for reference food glucose (50 g) shows t – value for 0-1 hour (4.75) which is statistically highly significant. At 0-2 hour t- value is (1.53) which is not significant and at 1-2 hour t- value is 3.15 which is highly significant. The above statistical result shows there was peak rise in glucose level at 0-1 hour but post prandial glucose dropped to normal glucose level in testing subjects who were non diabetic. REF. FOOD N MEAN STANDARD DEVIATION 't' 0 HOUR 1 HOUR 10 10 89.0000 108.2000 8.8819 9.1869 4.75 ** 0 HOUR 2 HOUR 10 10 89.0000 95.2000 8.8819 9.2352 1.53 NS 1 HOUR 2 HOUR 10 10 108.2000 95.2000 9.1869 9.2352 3.156 **

121 Table 4.37 POHA N MEAN STANDARD DEVIATION 't' 0 HOUR 1 HOUR 10 10 91.9000 111.4000 6.2619 7.9190 6.10 ** 0 HOUR 2 HOUR 10 10 91.9000 120.8000 6.2619 10.8812 7.28 ** 1 HOUR 2 HOUR 10 10 111.4000 120.8000 7.9190 10.8812 2.20 * The t-value for 0-1 hour is (6.10) , 0-2 hour(7.28) and 1-2(2.20) hour were highly significant and significant respectively. Hence, test food poha shows peak rise in glucose levels post prandial results.

122 Table no. 4.38 UPMA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 87.4000 113.6000 6.5524 10.7207 6.59 ** 0 HOUR 2 HOUR 10 10 87.4000 103.6000 6.5524 6.3805 5.60 ** 1 HOUR 2 HOUR 10 10 113.6000 103.6000 10.7207 6.3805 2.53 * The t-value for 0-1 hour is (6.59) , 0-2 hour(5.60) and 1-2 hour (2.53) were highly significant and significant respectively. Hence, test food upma shows peak rise in glucose levels post prandial results

123 Table 4.39 BESAN KA PARATHA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 83.1000 96.5000 6.3849 9.7325 3.64 ** 0 HOUR 2 HOUR 10 10 83.1000 90.4000 6.3849 10.8136 1.83 NS 1 HOUR 2 HOUR 10 10 96.5000 90.4000 9.7325 10.8136 1.32 NS The t- value for 0-1 hr is (3.64), 0-2 hour (1.83) and 1-2 hour (1.32) were highly significant and not significant respectively. Hence, test food besan parantha shows peak rise in glucose level at 0-1 hour but later drops down to normal level post prandial.

124 Table 4.40 BESAN CHEELA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 89.4000 124.9000 6.3805 6.5056 12.32 ** 0 HOUR 2 HOUR 10 10 89.4000 114.8000 6.3805 6.9889 8.48 ** 1 HOUR 2 HOUR 10 10 124.9000 114.8000 6.5056 6.9889 3.34 **(t- value for test food besan cheela at 0-1 hour(12.32), 0-2hour(8.48) and 1-2 hour (3.34) shows that they are highly significant. Hence, it shows that besan cheela has peak rise in blood glucose level post prandial.

125 Table 4.41 RAAB N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 88.2000 95.0000 8.0664 7.5130 1.95 NS 0 HOUR 2 HOUR 10 10 88.2000 90.9000 8.0664 6.3500 0.83 NS 1 HOUR 2 HOUR 10 10 95.0000 90.9000 7.5130 6.3500 1.31 NS t- value for test food raab at 0-1 hour (1.95) , 0-2 hour(0.83) and 1-2 hour (1.31)shows that they are not significant. Hence , it shows that raab has no remarkable rise in post prandial glucose level.

126 Table 4.42 PATOLIYA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 86.0000 93.5000 8.0691 4.8819 2.51 * 0 HOUR 2 HOUR 10 10 86.0000 89.6000 8.0691 4.1952 1.25 NS 1 HOUR 2 HOUR 10 10 93.5000 89.6000 4.8819 4.1952 1.91 NS t – value for test food patoliya at 0-1 hour (2.51), 0-2 hour(1.25) and 1-2 hour (1.91) shows significance at 0-1 hour and not significant for other two variables respectively. Hence , it shows that patoliya gives peak rise in blood glucose level in first hour but drops down to normal level post prandial.

127 Table 4.43 GATTE KI SAJI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 89.0000 123.5000 6.6165 9.7079 9.28 ** 0 HOUR 2 HOUR 10 10 89.000 113.1000 6.6165 7.3098 7.73 ** 1 HOUR 2 HOUR 10 10 123.5000 113.1000 9.7097 7.3098 2.70 * T – value for test food gate ki sabji at 0-1 hour(9.28) , 0-2 hour (7.33) and 1-2 hour(2.70) shows high signifance and significance respectively. Hence it shows there is peak rise in blood glucose level post prandial

128 Table 4.44 PITTOR KI SAJI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 88.3000 119.3000 5.8509 6.0378 11.66 ** 0 HOUR 2 HOUR 10 10 88.3000 111.3000 5.8509 5.9264 8.73 ** 1 HOUR 2 HOUR 10 10 119.3000 111.3000 6.0378 5.9264 2.99 ** t– value for test food pittor ki sabji at 0-1 hour (11.66) , 0-2 hour (8.73) and 1-2 hour (2.99) shows high significance. Hence, it gives peak rise in blood glucose at post prandial level.

129 Table 4.45 PAPAD KI SABJI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 87.4000 93.0000 6.8993 6.9602 1.80 NS 0 HOUR 2 HOUR 10 10 87.4000 89.8000 6.8993 6.8118 0.78 NS 1 HOUR 2 HOUR 10 10 93.0000 89.9000 6.9602 6.8118 1.03 NS t- value for test food papad ki sabji at 0-1hour (1.80), 0-2 hour(0.78) and at 1-2 hour(1.03) shows no significance. Hence, no prominent increase in blood glucose at post prandiallevel.

130 Table 4.46 BADI KI SABJI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 83.200 90.1000 5.2707 6.4023 2.61 * 0 HOUR 2 HOUR 10 10 83.2000 87.2000 5.3707 5.8462 1.59 NS 1 HOUR 2 HOUR 10 10 90.1000 87.2000 6.4023 5.8462 1.05 NS t- value for badi ki sabji at 0-1 hour(2.61), 0-2 (1,59) 1-2 (1.05) shows significance at 0-1 hour and no significance for other two variables respectively.Hence, there is no remarkable rise in blood glucose at post prandial.

131 Table 4.47 KABULI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 91.8000 126.2000 4.7329 5.3083 15.29 ** 0 HOUR 2 HOUR 10 10 91.8000 106.3000 4.7329 10.7708 3.89 ** 1 HOUR 2 HOUR 10 10 126.2000 106.3000 5.7194 10.7708 5.24** t- value for test food kabuli at 0-1 hour(15.29) at 0-2 hour(3.89) at 1-2 hour (5.24) were highly significant. Hence, it shows peak rise in blood glucose level post prandial.

132 Table 4.48 DAL BATI N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 84.4000 122.4000 5.7194 6.3979 14.00 ** 0 HOUR 2 HOUR 10 10 84.4000 104.2000 5.7219 4.7796 8.40 ** 1 HOUR 2 HOUR 10 10 122.4000 104.2000 6.3979 4.7796 7.20 ** t- value for test food daal- baati at 0-1 hour(14.00) at 0-2 hour(8.40) at 1-2 hour (7.20) were highly significant. Hence, it shows peak rise in blood glucose level post prandial.

133 Table 4.49 MIRCHIWADA N MEAN STANDARD DEVIATION ‘t’ 0 HOUR 1 HOUR 10 10 90.5000 110.7000 3.8944 8.8575 6.60 ** 0 HOUR 2 HOUR 10 10 90.5000 104.7000 3.8944 7.3492 5.39 ** 1 HOUR 2 HOUR 10 10 110.7000 104.7000 8.8575 7.3492 1.64 NS t- value for test food mirchiwada at 0-1 hour(6.60) at 0-2 hour(5.39) at 1-2 hour (1.64) were highly

significant at first two variables but no significance was seen at 1-2 hours. Hence, it shows rise in blood glucose level post prandial.

134 Table 4.50 KACHORI N MEAN STANDARD DEVIATION 't' 0 HOUR 1 HOUR 10 10 94.0000 118.5000 4.4222 5.3385 11.17 ** 0 HOUR 2 HOUR 10 10 94.0000 116.1000 4.4222 7.7810 7.80 ** 1 HOUR 2 HOUR 10 10 118.5000 116.1000 5.3385 7.7810 0.80 NS t- value for test food kachori at 0-1 hour(11.17) at 0-2 hour(7.80) at 1-2 hour (0.80) were highly significant at first two variables but no significance was seen at 1-2 hours. Hence, it shows rise in blood glucose level post prandial.

135 Table 4.51 SAMOSA N MEAN STANDARD DEVIATION 't' 0 HOUR 1 HOUR 10 10 92.2000 118.2000 4.4171 7.2847 9.65 ** 0 HOUR 2 HOUR 10 10 92.2000 108.9000 4.4171 6.0452 7.05 ** 1 HOUR 2 HOUR 10 10 118.2000 108.9000 7.2847 6.0452 3.10 ** t- value for test food samosa at 0-1 hour (9.65) at 0-2 hour (7.05) and at 1-2 hour (3.10) were highly significant . Hence it shows peak rise in glucose level post prandial. NOTE:- * denotes significance at 0.05 level. ** denotes significance at0.01 level.

136 Table 4.52, 4.53 and 4.54 showing the pearson's coefficient of correlation of test goods at o hour, 1 hour and 2 hour blood glucose screening. Table 4.52 showing correlation among the variable (reference food and test foods) at 0 hour of blood glucose screen Poha Upma Besan paratha Besan cheela Raab Patoliya Gatte ki sabji Pittor ki sabji Papad ki sabji Badi ki sabji Kabuli Dal bati Mirchiwada Kachori Samosa Ref. food -.493 -.053 -.202 -.369 -.349 -.557 .270 -.481 -.176 -.170 .217 .212 .135 .422 .159 Poha .028 .614 .541 .311 .600 -.276 .216 .562 .774 ** .022 .389 -.166 -.056 .001 Upma -.041 -.262 .257 .391 .515 .220 -.385 .102 -.613 .419 -.087 -.199 -.260 Besan paratha .493 -.374 .364 -.434 -.382 .284 .576 .129 .200 -.235 -.433 -.296 Besan cheela .195 .378 -.816 ** .154 .791 ** .458 .378 -.002 -.519 -.378 -.421 Raab .242 -.046 .625 .398 .168 .077 .282 .021 .084 =.182 Patoliya .102 .195 -.026 .223 -.381 .104 -.212 -.156 -.203 Gatte ki sabji -.115 -.767 ** -.272 -.536 .261 .306 .433 .483 Pittor ki sabji .203 .030 -.439 -.263 -.090 -.017 -.093 Papad ki sabji .567 .636 * .226 -.223 -.040 -.207 Badi ki sabji .063 .692 * -.531 -.304 .167 Kabuli .143 .187 .170 -.179 Dal bati -.215 .013 .199 Mirchiwada .684* -.071 Kachori .375 Samosa The above table 4.52 shows significance and correlation among two variables at 0-1 hour. Significance at .01 level (**) Very high significance and negative correlation among test food (gate ki sabji and besan ka cheela -.816). High significance and positive correlation among (papad ki sabji and besan ka cheela.791). High significance and negative correlation among(papad ki sabji and gate ki sabji -.767),High significance and positive correlation among (badi ki sabji and poha .774). Significance at .05 level(*) High significance and positive correlation among(kabuli and papad ki sabji .636).High significance and positive correlation among (dal baati and badi ki sabji .692). High significance and positive correlation among (kachori and mirchiwada .684).

137 Table 4.53 showing correlation among the variable (reference food and test foods) at 1 hour of blood glucose screen Poha Upma Besan paratha Besan cheela Raab Patoliya Gatte ki sabji Pittor ki sabji Papad ki sabji Badi ki sabji Kabuli Dal bati Mirchiwada Kachori Samosa Ref. food -.123 .467 .142 -.052 .053 -.342 .777 ** .245 -.210 -.195 .735 * .581 .144 -.186 .169 Poha .075 .346 .012 -.103 -.296 -.301 .318 .591 .707 * -.274 -.207 .213 -.176 .020 Upma .525 .388 -.604 -.217 .407 .158 -.411 -.203 .390 .361 -.122 .115 .592 Besan paratha .478 -.579 -.490 .269 -.010 -.123 -.169 .052 .366 .119 .121 .020 Besan cheela -.107 .352 -.024 .004 -.361 -.085 .435 .207 -.384 .088 -.096 Raab .388 -.200 .176 .478 .374 .306 -.192 -.055 -.468 -.382 Patoliya -.444 -.273 .026 .180 .219 -.583. -.109 -.245 -.431 Gatte ki sabji .340 -.350 -.380 .382 .794 ** -.163 -.136 .209 Pittor ki sabji .233 .200 -.044 .471 -.326 -.088 .370 Papad ki sabji .785 ** -.301 -.529 .308 -.655 * -.329 Badi ki sabji -.131 -.497 -.060 -.688 * -.115 Kabuli .305 -.029 -.216 -.059 Dal bati -.390 .283 .399 Mirchiwada .048 -.485 Kachori .297 Samosa Significance at .01 level (**) Highly significant and positive correlation among Gate ki sabji and ref food (.777) High significance and positive correlation among Badi ki sabji and papad ki sabji (.785) High significance andpositive correlation among dal baati and gate ki sabji (.794) Significance at .05 level(*) High significant and positive correlation among Badi ki sabji and poha (.707) High significance and positive correlation among Kabuli and reference food (.735) High significance and negative correlation among kachori and papad ki sabji (- .655) High significance and negative correlation among kachori and badi ki sabji(-688)

138 Table 4.54 showing correlation among the variable (reference food and test foods) at 2 hour of blood glucose screen Poha Upma Besan paratha Besan cheela Raab Patoliya Gatte ki sabji Pittor ki sabji Papad ki sabji Badi ki sabji Kabuli Dal bati Mirchiwada Kachori Samosa Ref. food .025 .122 -.193 -.221 .315 -.024 .018 .307 .322 .466 .582 -.565 -.403 .001 .205 Poha .306 .748 * .593 -.460 -.416 -.051 .144 -.115 -.027 -.476 -.514 .584 .559 .055 Upma .238 .165 -.796 ** -.189 .385 .300 -.674 -.287 -.027 -.194 .099 .666 * .396 Besan paratha .200 -.418 -.616 .296 .260 -.082 -.237 -.497 -.092 .783 ** .411 -.128 Besan cheela -.251 .440 -.287 -.130 -.099 .055 -.356 -.501 .014 .307 -.032 Raab .315 -.076 -.156 .585 .267 .424 .074 -.448 -.501 -.342 Patoliya -.372 -.200 .238 .321 .244 -.206 -.714 * -.380 -.054 Gatte ki sabji .471 -.361 -.411 -.055 .257 .168 .459 .046 Pittor ki sabji .098 .235 =.402 -.497 -.028 .129 .711 * Papad ki sabji .087 ** .163 -.323 -.186 -.740 * -.235 Badi ki sabji .149 -.630 -.446 -.660 * .148 Kabuli .143 -.479 -.209 -.406 Dal bati .268 -.057 -.495 Mirchiwada .449 -.263

Kachori .137 Samosa Significance at .01 level (**) High significance and negative correlation among raab and upma (-.796); Very high significance and positive correlation among badi ki sabji and papad ki sabji (.807) High significance and positive correlation among mirchiwada and besan parantha (.783) Significance at .05 level (*) High significance and positive correlation among besan parantha and poha (.748); High significance and negative correlation among mirchiwada and patoliya (-.714) High significance and positive correlation among kachori and upma (.666); High significance and negative correlation among kachori and papad ki sabji (-.740) High significance and negative correlation among kachori and badi ki sabji (-.660); High significance and positive correlation among samosa and pittor ki sabji (.711) Significance of degree of correlation ±.00 to ± .20 = Very Low ± .21 to ± .40 = Low ± .41 to ± .60 = Average ± .61 to ± .80 = High ± .81 to 1.00 = Very High

Chapter-5 CONCLUSION AND RECOMMENDATIONS

140 T Chapter – 5 CONCLUSION AND RECOMMENDATIONS he present study was carried out at THE ENDO CLINIC of Jodhpur city, Rajasthan to estimate glycemic index of local foods consumed by diabetic patients of Jodhpur city and its impact on their blood glucose level. Accordingly, a total 310 subjects were studied out of which 150 males and 150 females aged between 35-45 years were selected .The data includes general information on the basis of age, education, eating habits. The more emphasis was given over the consumption pattern of local foods on the basis of their daily meal pattern so as to list out the frequently consumed food items General information was collected on the basis of table no.4.1, 4.2 and 4.3 information regarding age, education and eating habits are shown in percentage with respective graphical representation. The results showedthat 41%

males and 24% females

of age.On the basis of percentagemean of subjects education, both the subjects were under the category of literate. None of them was under illiterate category.Percentage distribution on the basis of eating habits was calculated, where both the subjects were under vegetarian category. As per the need of the study, two different groups of subjects were selected .In the first part of study, the criteria was to collect information and data regarding food consumption pattern and frequency of local foods among diabetic subjects so that the pattern of consumption and most frequently consumed foods can be listed out. From the information collected by the diabetic subjects foods were categorized on the basis of food frequency questionnaire.

141 The second part of the study, 10 healthy and non -diabetic subjects were selected for testing the and estimating Glycemicindex of 15 highly consumed foods and on the basis of glucose readings glycemic index was calculated and foods were classified on the basis of classification table. The results and statistical analysis showed that all the foods were under the range of very high and moderately high GI list, which shows that higher the ranking of food's GI faster it will increase the glucose levels. The present study concludes that the local foods consumed by diabetic patients of jodhpur city are high in their Glycemic index ranking. As the results showed, higher The GI ,higher will be the incremental peak rise in blood sugar levels. When these foods will be consumed by type 2 diabetic patients, there will be risein their blood glucose level as high glycemic index and deficit in the insulin will show peak rise than the normal range. Therefore, diabetic patients consuming high GI foods will be at risk of abnormal rise in the blood sugar after consumption of these foods. Foods like besancheela, gatte, pittor, mirchiwadapoha ,upma have ranking of GI obove 100 on the scale(more than 100- very high) which is considered as very high in ranking. The results will be a helping tool in management of diabetes as by portion control ,intake pattern, reduction in frequency and by understanding the concept of glycemic index ,dabetes can be managed and correct dietary guidelines can help diabetics to select the food wisely.

Recommendations:- ❖ Further studies are needed to assess glycemic index of staplefoods among rural sections of community. ❖ Further research can be done on actions of glycemic index of ready to eat food (packed food) among Type 1 ,LADA and MODY diagnosed population. ❖ Further research can be done onestimating (Meal) glycemic index as it has become need of the present era to assess the glycemic index of complete meal. ❖ Further studies on coping strategies and implementation of glycemic index values in meal planning by the nutritionist can be a great step in managing diabetes. ❖ Further studies on reduction of glycemic index ranking of locally consumed foods by diabetic patients of Jodhpur can help in diabetes management and can delay the rise in blood glucose level.

Curiginal

Hit and source - focused comparison, Side by Side

Submitted text As student entered the text in the submitted document.

Matching text As the text appears in the source.

1/24	SUBMITTED TEXT	79 WORDS	73%	MATCHING TEXT	79 WORDS

the management of diabetes mellitus, diet has been recognized as a cornerstone of the therapy. There is a considerable evidence to show that good control of blood glucose prevents or delay the debilitating complications of diabetes. The use of carbohydrate both in terms of quantity as well as quality in diabetes meal planning has always been a key therapeutic issue. The amount of total carbohydrate recommended for diabetic diet has varied significantly over the years.	the management of diabetes mellitus, diet has been recognized as a cornerstone of therapy. There is considerable evidence to show that better control of blood sugar prevents or delays the debilitating complications of diabetes 1 . The use of carbohydrate both in terms of quantity as well as quality in diabetic diet, has always been a key therapeutic issue 2 . The amount of total carbohydrate recommended for the diabetic diet has varied significantly over the years 3 .

W https://www.researchgate.net/publication/12366675_Glycemic_responses_to_cereal-based_Indian_food_ ...

3/24	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

There are many traditional beliefs regarding the type of carbohydrate in the diabetic diet, which in	There are many traditional beliefs regarding the type of carbohydrate in the diabetic diet, which in

W https://www.researchgate.net/publication/12366675_Glycemic_responses_to_cereal-based_Indian_food_ ...

2/24	SUBMITTED TEXT	18 WORDS	91%	MATCHING TEXT	18 WORDS

recent years are questioned. According to traditional thoughts, simple sugars are rapidly digested and absorbed and therefore	recent years are questioned. According to traditional thought, simple sugars are rapidly digested and absorbed and therefore

W https://www.researchgate.net/publication/12366675_Glycemic_responses_to_cereal-based_Indian_food_ ...

4/24	SUBMITTED TEXT	21 WORDS	80%	MATCHING TEXT	21 WORDS

is defined as the area under the glucose response curve after consumption of 50 g carbohydrate from a test food	is defined as the area formed under the glycemic response curve, after the consumption of 50g of available carbohydrate from a test food,

W https://www.researchgate.net/publication/8891268_Effect_of_blood_sampling_schedule_and_method_of_ ...

5/24	SUBMITTED TEXT	23 WORDS	100% MATCHING TEXT	23 WORDS

Many factors together, including carbohydrate type, fiber, protein, fat, food form and method of preparation, determine the GI of a particular food (

Many factors together, including carbohydrate type, fiber, protein, fat, food form and method of preparation, determine the GI of a particular food.

W http://www.suaire.sua.ac.tz/bitstream/handle/123456789/1469/CAROLYNE%20CHARLES%20RUHEMBE.pdf?sequ ...

6/24	SUBMITTED TEXT	16 WORDS	85% MATCHING TEXT	16 WORDS

Analysis of Data: Data was statistically analyzed as per the objectives of the study.

SA 1 Niharika Phd PDF file 2017.pdf (D29825434)

22/24	SUBMITTED TEXT	74 WORDS	72% MATCHING TEXT	74 WORDS

Standard Deviation √ ∑( )= mean of observations N = number of observations 79 Standard Error √ σ, = standard deviation N = number of observation T – test

SA 1 Niharika Phd PDF file 2017.pdf (D29825434)

7/24	SUBMITTED TEXT	24 WORDS	62% MATCHINGTEXT	24 WORDS

were under the age group of 35-40 years whereas 52% males and 76% females were under the age group of 40-45 years

SA C VD Methodology and Results Discussion.docx (D30208825)

8/24	SUBMITTED TEXT	41 WORDS	52% MATCHING TEXT	41 WORDS

Percentage distribution of subjects on the basis of Education 100 90 80 70 60 50 40 30 20 10 0 Literate IlliterateMalesubjectsFemalesubjectsPercentage85 Table 4.3 Percentage distribution of subjects on the basis of

SA Vaishya.R.D(18FSN22)MSc Thesis (1) (3).pdf (D77694297)

Curiginal

9/24	SUBMITTED TEXT	18 WORDS	100% MATCHING TEXT	18 WORDS

Male (n=150) % Female (n= 150) % Once a week 40 25.33
Twice a week 32.66 20

SA Sona thesis.doc (D21444835)

12/24	SUBMITTED TEXT	17 WORDS	100% MATCHING TEXT	17 WORDS

Male (n=150) % Female (n=150) % Once a week 36 44.66
Twice a week 30.66 22.66

SA Sona thesis.doc (D21444835)

10/24	SUBMITTED TEXT	27 WORDS	62% MATCHING TEXT	27 WORDS

frequency - Patoliya 40 35 30 25 20 15 10 5 0 Male
(n=150) Females (n=150) Once a week Twice a week On
week Monthly Rarely

SA Sona thesis.doc (D21444835)

11/24	SUBMITTED TEXT	17 WORDS	100% MATCHING TEXT	17 WORDS

Male (n=150) % Female (n=150) % Once a week 25.33
29.33 Twice a week 27.33 33.33

SA Sona thesis.doc (D21444835)

15/24	SUBMITTED TEXT	13 WORDS	83% MATCHING TEXT	13 WORDS

Male (n=150) Female (n=150) Once a Twice a On week
Monthly Rarely

SA Sona thesis.doc (D21444835)

13/24	SUBMITTED TEXT	17 WORDS	100% MATCHING TEXT	17 WORDS

Male (n=150) % Female (n=150) % Once a week 36 32.66
Twice a week 25.33 24.66

SA Sona thesis.doc (D21444835)

14/24	SUBMITTED TEXT	17 WORDS	100%	MATCHING TEXT	17 WORDS

Male (n=150) % Female (n=150) % Once a week 48.66 40.66 Twice a week 26 22

SA Sona thesis.doc (D21444835)

16/24	SUBMITTED TEXT	17 WORDS	100% MATCHING TEXT	17 WORDS

Male (n=150) % Female (n=150) % Once a week 46 34.66 Twice a week 22.66 11.33

SA Sona thesis.doc (D21444835)

17/24	SUBMITTED TEXT	15 WORDS	78% MATCHING TEXT	15 WORDS

Male (n=150) Female (n=150) Once a week Twice a week On week Monthly Rarely

SA Sona thesis.doc (D21444835)

18/24	SUBMITTED TEXT	18 WORDS	100% MATCHING TEXT	18 WORDS

Male (n=150) % Female (n=150) % Once a week 12 14 Twice a week 8.99 6.66

SA Sona thesis.doc (D21444835)

19/24	SUBMITTED TEXT	17 WORDS	78% MATCHING TEXT	17 WORDS

Male (n=150) Female (n=150) 10 0 Once a week Twice a week On week Monthly Rarely

SA Sona thesis.doc (D21444835)

21/24	SUBMITTED TEXT	18 WORDS	100% MATCHING TEXT	18 WORDS

Male (n=150) % Female (n=150) % Once a week 32.66 37.33 Twice a week 8.99 12

SA Sona thesis.doc (D21444835)

Curiginal

20/24	SUBMITTED TEXT	18 WORDS	78% MATCHING TEXT	18 WORDS

Male (n=150) Female (n=150) 10 0 Once a week Twice a week On week Monthly Rarely

SA Sona thesis.doc (D21444835)

23/24	SUBMITTED TEXT	11 WORDS	100% MATCHING TEXT	11 WORDS

subjects who were willing to participate in the study were

SA Supriya v.docx (D93456152)

24/24	SUBMITTED TEXT	23 WORDS	62% MATCHING TEXT	23 WORDS

were under the age group of 35-40 years whereas 52% males and 76% females were under the age group of 40-45 years

SA C VD Methodology and Results Discussion.docx (D30208825)

COURSE WORK CERTIFICATE

JAI NARAIN VYAS UNIVERSITY, JODHPUR

FACULTY OF SCIENCE

CERTIFICATE

Date : 8/10/2013 No. 10

This is to certify that Mr./Ms. Khushboo Vyas

_____ in the Department of Home Science

Jai Narain Vyas University, Jodhpur has qualified the course work organized by the university during Session 2013-14.

This Certificate is issued in accordance with the provisions of UGC (Minimum Standards and Procedure for Award of M.Phil/Ph.D. Degree) Regulations 2009 notified in the Gazette of India on 11th July 2009.

Professor & Head
Department of Home Science
Jai Narain Vyas University
Jodhpur

HEAD

Dean
Faculty of Science
J.N.V. University
JODHPUR

DEAN

PRE Ph.D PRESENTATION CERTIFICATE

Prof. Ashok Purohit
Dean, Faculty of Science,
In-charge, Dept. Home Science
Jai Narain Vyas University, New Campus,
New Pali Road, Jodhpur (Rajasthan)

0291-2720522 (O)

homesciencejnvu@gmail.com

No. J.N.N.U. /Sc. /P.G. /H. Sc. /19/ 3449

Date 24/10/2019

TO WHOM IT MY CONCERN

This is to certify that Ms. Khushboo Vyas, Research Scholar of the Department of Home Science, J. N. V. University, Jodhpur has delivered her **Pre. Ph. D Presentation** on the topic **"ESTIMATION OF GLYCEMIC INDEX OF LOCAL FOODS CONSUMED BY DIABETIC PATIENTS OF JODHPUR CITY AND ITS IMPACT ON THEIR BLOOD GLUCOSE LEVEL"** in the Department of Home Science on 24th Oct. 2019. Her presentation was satisfactory at 11.30 P. M.

Dr. Ashok Purohit
Professor & Head

Professor & Head
Department of Home Science
Jai Narain Vyas University
Jodhpur

प्रो. (डॉ.) चन्दन बाला
आचार्य

विधि संकाय
जय नारायण व्यास विश्वविद्यालय
जोधपुर (राज.) 342001

साहित्यिक समरूपता विश्लेषण प्रमाणपत्र

1	शोधकर्ता का नाम	दिनेश चौहान
2	अध्ययन का कोर्स	पीएच.डी. (विधि)
3	शोध अध्ययन का शीर्षक	भारतीय संविधान में वर्णित मौलिक अधिकार, निदेशक सिद्धांत और मौलिक कर्त्तव्य में परस्पर सम्बन्ध एवं सामाजिक व आर्थिक न्याय की प्राप्ति में योगदान – एक आलोचनात्मक अध्ययन
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5	विभाग का नाम	विधि संकाय जयनारायण व्यास विश्वविद्यालय, जोधपुर
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7	पहचान की गई सामग्री की समानता का प्रतिशत	8 प्रतिशत
8	सॉफ्टवेयर	उरकुण्ड (Urkund)
9	सत्यापन की तारीख	22 सितम्बर 2021

उरकुंड समरूपता विश्लेषण रिपोर्ट :

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Analyzed document	Dinesh Chouhan Chapters-1-8.docx (D113163567)
Submitted	2021-09-22 11:19:00
Submitted by	Prof .Dr. CHANDAN BALA
Submitter email	dr_chandanbala@yahoo.co.in
Similarity	8%
Analysis address	dr_chandanbala.jnvu@analysis.urkund.com

दिनांक : 22 सितम्बर 2021

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पर्यवेक्षक के हस्ताक्षर
Research Supervisor
Faculty of Law
J.N Vyas University
Jodhpur

JAI NARAIN VYAS UNIVERSITY

FACULTY OF LAW

☎ 0291-2513440 (O)
Email: jnvulaw@gmail.com

JODHPUR (RAJASTHAN) - 342001

Certificate

This is to certify that Mr. **DINESH CHOUHAN** *S/o Mr.* **GHANSHYAM CHOUHAN** *in the Faculty of Law, Jai Narain Vyas University, Jodhpur has qualified the Course Work organized by the University.*

This Certificate is issued in accordance with the provisions of UGC (Minimum standards and procedure for award of M.Phil./Ph.D. degree) Regulations 2009 notified in the gazette of India on 11th July, 2009.

(Prof. R.K. Sinha)
Head & Dean

Date : 7th November, 2013

JAI NARAIN VYAS UNIVERSITY, JODHPUR
FACULTY OF LAW

No. JNVU/Law/2020/ 4352
9th July, 2020

CERTIFICATE

This is to certify that Mr. Dinesh Chouhan has delivered his Pre-Ph.D. Presentation on the topic "भारतीय संविधान में वर्णित मौलिक अधिकार, निदेशक सिद्धांत और मौलिक कर्त्तव्य में परस्पर सम्बन्ध एवं सामाजिक व आर्थिक न्याय की प्राप्ति में योगदान - एक आलोचनात्मक अध्ययन" before the undersigned and Faculty Members of the Faculty of Law on 9th July, 2020 at 1:30 p.m.

(Prof. Chandan Bala)
Head & Dean

Dean & Head
Faculty of Law
J N Vyas University
Jodhpur

CERTIFICATE

This is to certify that **Mr. Dinesh Chouhan** doing Research under my supervision and guidance. He has fulfilled the requirements of Ordinance 211 regarding residence in the University for a period of more than 5 years from the date of commencement of his work.

(Prof. Chandan Bala)
Research Supervisor
& Professor of Law
Faculty of Law
J.N. Vyas University
Jodhpur

Date: _____

प्रो. (डॉ.) चन्दन बाला
आचार्य

विधि संकाय
जय नारायण व्यास विश्वविद्यालय
जोधपुर (राज.) 342001

साहित्यिक समरूपता विश्लेषण प्रमाणपत्र

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9	सत्यापन की तारीख	22 सितम्बर 2021

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दिनांक : 22 सितम्बर 2021

शोधार्थी के हस्ताक्षर

पर्यवेक्षक के हस्ताक्षर
Research Supervisor
Faculty of Law
J.N Vyas University
Jodhpur

JAI NARAIN VYAS UNIVERSITY

FACULTY OF LAW

☎ 0291-2513440 (O)
Email: jnvulaw@gmail.com

JODHPUR (RAJASTHAN) - 342001

Certificate

This is to certify that Mr. **DINESH CHOUHAN** *S/o Mr.* **GHANSHYAM CHOUHAN** *in the Faculty of Law, Jai Narain Vyas University, Jodhpur has qualified the Course Work organized by the University.*

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(Prof. R.K. Sinha)
Head & Dean

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FACULTY OF LAW

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(Prof. Chandan Bala)
Head & Dean

Dean & Head
Faculty of Law
J N Vyas University
Jodhpur

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(Prof. Chandan Bala)
Research Supervisor
& Professor of Law
Faculty of Law
J.N. Vyas University
Jodhpur

Date: _____

Prof. (Dr.) S.P.S. Bhadu

Dept. of Management Studies
Jai Narain Vyas University
Jodhpur (Raj.)

CERTIFICATE OF PLAGIARISM CHECK

Name of Research Scholar	VEENUS GEHLOT
Course of Study	DOCTOR OF PHILOSOPHY
Title of the thesis	A STUDY OF CORPORATE SOCIAL ENTREPRENEURSHIP IN SELECTED BUSINESS ORGANIZATIONS OF RAJASTHAN
Name of Supervisor	PROF. (DR.) S.P.S. BHADU
Department	MANAGEMENT STUDIES
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Date of Verification	26-MAR-2020

TURNITIN analysis report is attached

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(Opposite Senapati Bhawan)

No. JNVU/DMS/19-20/613 Feb.27, 2020

CERTIFICATE FOR PRE. Ph.D. PRESENTATION

This is to certify that Ms. Veenus Gehlot has made Pre. Ph.D presentation as per UGC Guideline, University Grant Commission (Minimum standard and procedure award of Ph.D.) Regulation 2009 and Jai Narain Vyas University Ordinance for Ph.D. programme on the research work entitled reference to 'A STUDY OF CORPORATE SOCIAL ENTREPRENURSHIP IN SELECTED BUSINESS ORGANIZATIONS OF RAJASTHAN" in the Department of Management Studies, Jai Narain Vyas University, Jodhpur on dated 27/02/2020 before all the faculty members, research scholars of the department for getting feedback and comments. The research work was highly appreciated by all those who were present.

(Prof. S.P.S. Bhadu)
Supervisor & Professor & Head
Dept. of Management Studies

PROFESSOR
Department of Management Studies
Faculty of Commerce & Mgt. Studies
Jai Narain Vyas University, Jodhpur

(Prof . S.P.S. Bhadu)
Head
Dept. of Management Studies

HEAD
Department of Management Studies
Faculty of Comm. & Mgt. Studies
Jai Narain Vyas University
JODHPUR (Rajasthan)

DEPARTMENT OF MANAGEMENT STUDIES

FACULTY OF COMMERCE AND MANAGEMENT STUDIES
JAI NARAIN VYAS UNIVERSITY, JODHPUR

No. JNVU/DMS/2015/२१९७ Date: 25/03/2015

CERTIFICATE

This is to certify that **Ms. Veenus Gehlot** in the Department of Management Studies, Jai Narain Vyas University, Jodhpur has qualified the Course-Work organized by the University.

This Certificate is issued in accordance with the provisions of UGC (Minimum standards and procedure for award of M.Phil/Ph.D. degree) Regulations 2009 notified in the gazette of India on 11th July, 2009.

HEAD
HEAD
Department of Management Studies
Faculty of Comm. & Mgt. Studies
Jai Narain Vyas University
JODHPUR (Rajasthan)

DATE:

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Faculty of Commerce & Management Studies
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DEPARTMENT OF MANAGEMENT STUDIES
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JAI NARAIN VYAS UNIVERSITY, OPP. SENAPATI BHAWAN,
RESIDENCY ROAD, JODHPUR
E-mail: spsbhadu@gmail.com M.: 9414471679

Professor (Dr.) S.P.S. Bhadu

Head

CERTIFICATE

*This is to certify that the present piece of research work entitled "**A Study of Corporate Social Entrepreneurship in Selected Business Organizations of Rajasthan**" has been done by **Ms. Veenus Gehlot** under my supervision in the partial fulfillment of requirements for the award of the degree of Doctor of Philosophy in Management Studies.*

I certify that this research work is an original study of the scholar and the findings made by the candidate do not form the part of any other's research work.

I recommend that this thesis be accepted, for the submission in the Jai Narain Vyas University for the award of degree of Doctor of Philosophy in the Department of Management Studies, Faculty of Commerce and Management Studies.

Prof. (Dr.) S.P.S. Bhadu
Head,
Department of Management Studies
J.N.V University, Jodhpur (Raj.).

Head
Department of Managment Studies
Faculty of Commerce & Mgt. Studies
Jai Narain Vyas University, Jodhpur

Prof. (Dr.) S.P.S. Bhadu
(Supervisor)

Prof. (Dr.) S.P.S. Bhadu

Dept. of Management Studies
Jai Narain Vyas University
Jodhpur (Raj.)

CERTIFICATE OF PLAGIARISM CHECK

Name of Research Scholar	VEENUS GEHLOT
Course of Study	DOCTOR OF PHILOSOPHY
Title of the thesis	A STUDY OF CORPORATE SOCIAL ENTREPRENEURSHIP IN SELECTED BUSINESS ORGANIZATIONS OF RAJASTHAN
Name of Supervisor	PROF. (DR.) S.P.S. BHADU
Department	MANAGEMENT STUDIES
Acceptance maximum limit	10%
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Software used	TURNITIN
Date of Verification	26-MAR-2020

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Signature of Research Scholar
(VEENUS GEHLOT)

Signature of Supervisor
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JAI NARAIN VYAS UNIVERSITY, JODHPUR
(Opposite Senapati Bhawan)

No. JNVU/DMS/19-20/613 Feb.27, 2020

CERTIFICATE FOR PRE. Ph.D. PRESENTATION

This is to certify that Ms. Veenus Gehlot has made Pre. Ph.D presentation as per UGC Guideline, University Grant Commission (Minimum standard and procedure award of Ph.D.) Regulation 2009 and Jai Narain Vyas University Ordinance for Ph.D. programme on the research work entitled reference to 'A STUDY OF CORPORATE SOCIAL ENTREPRENURSHIP IN SELECTED BUSINESS ORGANIZATIONS OF RAJASTHAN" in the Department of Management Studies, Jai Narain Vyas University, Jodhpur on dated 27/02/2020 before all the faculty members, research scholars of the department for getting feedback and comments. The research work was highly appreciated by all those who were present.

(Prof. S.P.S. Bhadu)
Supervisor & Professor & Head
Dept. of Management Studies

PROFESSOR
Department of Management Studies
Faculty of Commerce & Mgt. Studies
Jai Narain Vyas University, Jodhpur

(Prof . S.P.S. Bhadu)
Head
Dept. of Management Studies

HEAD
Department of Management Studies
Faculty of Comm. & Mgt. Studies
Jai Narain Vyas University
JODHPUR (Rajasthan)

DEPARTMENT OF MANAGEMENT STUDIES

FACULTY OF COMMERCE AND MANAGEMENT STUDIES
JAI NARAIN VYAS UNIVERSITY, JODHPUR

No. JNVU/DMS/2015/२१९७ Date: 25/03/2015

CERTIFICATE

This is to certify that **Ms. Veenus Gehlot** in the Department of Management Studies, Jai Narain Vyas University, Jodhpur has qualified the Course-Work organized by the University.

This Certificate is issued in accordance with the provisions of UGC (Minimum standards and procedure for award of M.Phil/Ph.D. degree) Regulations 2009 notified in the gazette of India on 11th July, 2009.

HEAD
HEAD
Department of Management Studies
Faculty of Comm. & Mgt. Studies
Jai Narain Vyas University
JODHPUR (Rajasthan)

DATE:

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DEAN
Faculty of Commerce & Management Studies
Jai Narain Vyas University
JODHPUR (RAJ.)

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PHONE: +91-0291-2513840, E-MAIL:dmsjodhpur@gmail.com

DEPARTMENT OF MANAGEMENT STUDIES
FACULTY OF COMMERCE & MANAGEMENT STUDIES
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E-mail: spsbhadu@gmail.com M.: 9414471679

Professor (Dr.) S.P.S. Bhadu

Head

CERTIFICATE

*This is to certify that the present piece of research work entitled "**A Study of Corporate Social Entrepreneurship in Selected Business Organizations of Rajasthan**" has been done by **Ms. Veenus Gehlot** under my supervision in the partial fulfillment of requirements for the award of the degree of Doctor of Philosophy in Management Studies.*

I certify that this research work is an original study of the scholar and the findings made by the candidate do not form the part of any other's research work.

I recommend that this thesis be accepted, for the submission in the Jai Narain Vyas University for the award of degree of Doctor of Philosophy in the Department of Management Studies, Faculty of Commerce and Management Studies.

Prof. (Dr.) S.P.S. Bhadu
Head,
Department of Management Studies
J.N.V University, Jodhpur (Raj.).

Head
Department of Managment Studies
Faculty of Commerce & Mgt. Studies
Jai Narain Vyas University, Jodhpur

Prof. (Dr.) S.P.S. Bhadu
(Supervisor)

DEPARTMENT OF PUBLIC ADMINISTRATION
J.N.V. UNIVERSITY
JODHPUR 342005 (Raj)

CERTIFICATE OF PLAGIARISM CHECK

1	**Name of the Research Scholar**	Neelu Purohit
2	**Course of the Study**	Ph.D. (Public Administration)
3	**Title of the Thesis**	"GST: Centre-State Relations and Tax Structure of India with Special Reference to Rajasthan",
4	**Name of the Supervisor**	Professor (Dr.) Jagmal Singh Shekhawat
5	**Department**	Department of Public Administration
6	**Acceptable Maximum Limit**	10%
7	**Percentage of Similarity of Content Identified**	1%
8	**Software Used**	TURNITIN
9	**Date OF Verification**	11 July 2020

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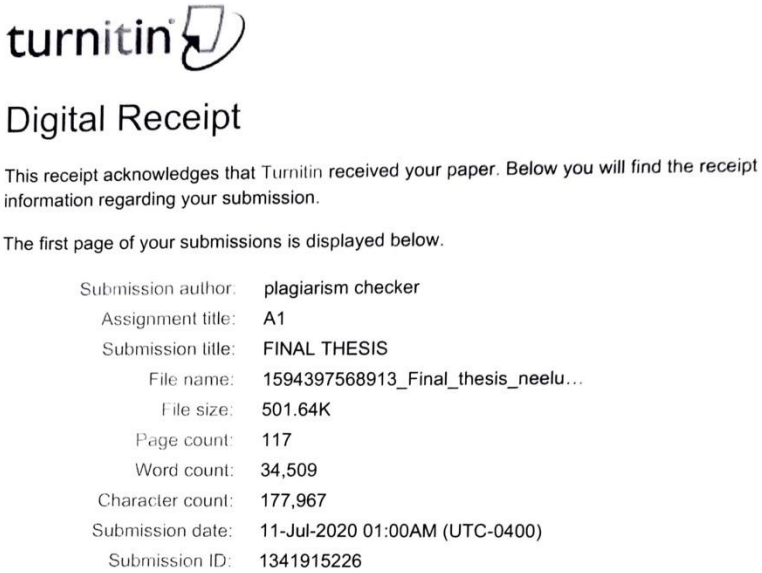

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Date:

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Head
Department of Public Administration
Jai Narain Vyas University
JODHPUR (Raj.)

Signature of Candidate
(Neelu Purohit)

DR. JAGMAL SINGH SHEKHAWAT
Professor & Head
Department of Public Administration
Jai Narain Vyas University
Jodhpur
Mobile:+91-9414475298

CERTIFICATE

This is to certify that the thesis entitled **"GST: Centre-State Relations and Tax Structure of India with Special Reference to Rajasthan",** submitted for the award of the Degree of Doctor of Philosophy in the Department of Public Administration, Faculty of Arts Education and Social Science, Jai Narain Vyas University, Jodhpur by **Mrs. NEELU PUROHIT**, Research Scholar, embodies the results of original research work carried out under my supervision. This work has not been submitted for any other degree in India or abroad.

Date: 01.09.2020

Dr. Jagmal Singh Shekhawat
Research Supervisor
Professor & Head

JAI NARAIN VYAS UNIVERSITY, JODHPUR
(DEPARTMENT OF PUBLIC ADMINISTRATION)

CERTIFICATE

This is to Certify that Ms. Neelu Purohit in the Department of Public Administration, Jai Narain Vyas University, Jodhpur has qualified the Course-Work organized by the university in the year 2015.

This Certificate is issued in accordance with the provisions of UGC (Minimum standards and procedure for award of M.Phil/Ph.D. degree) Regulations 2009 notified in the gazette of India on 11th July, 2009.

HEAD Head
Department of Public Administration
Jai Narain Vyas University
JODHPUR (Raj.)

DATE: 08.10.2016

8/10/2016

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Faculty of Arts, Edu.& Social Sciences
Jai Narain Vyas University
JODHPUR

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जयनारायण व्यास विश्वविद्यालय, जोधपुर

दिनांक :: 26 अगस्त, 2020

प्रमाण पत्र

यह प्रमाणित किया जाता है कि दिनांक 26 अगस्त, **2020 को प्रातः 8.15** बजे श्रीमती नीलू पुरोहित की प्री. पीएच.डी. मौखिक परीक्षा (Pre Ph.D. Viva-Voce) आयोजित की गयी। इस परीक्षा में विभाग के विभागाध्यक्ष एवं रिसर्च सुपरवाईजर प्रो. जगमाल सिंह शेखावत एवं विभाग के शोधार्थियों ने भाग लिया। प्री. पीएच.डी. मौखिक परीक्षा पश्चात् श्रीमती नीलू पुरोहित का शोध कार्य संतोषप्रद पाया गया एवं सर्वसम्मति से निर्णय लिया गया कि श्रीमती नीलू पुरोहित अपना शोध ग्रंथ जांच हेतु विभाग के माध्यम से विश्वविद्यालय के शैक्षणिक विभाग में जमा करावें।

(प्रो.जगमाल सिंह शेखावत)
Professor & Head
Department of Public Administration
J.N.V. University, Jodhpur
विभागाध्यक्ष

Prof.Jagmal Singh Shekhawat
Prof. & Head

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Residential Requirement Certificate

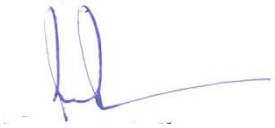
It is certified that **Ms. Neelu Purohit** Research Scholar in Public Administration, Department of Public Administration for her Ph.D. from **25.05.2016** to till today 01-07-**2020.** She has fulfilled the two years residential requirements as required under the University Ordinance.

(Dr.J.S.Shekhawat)
Research Supervisor

Professor & Head
Department of Public Administration
J.N.V.University, Jodhpur

DECLARATION

I, **NEELU** hereby declare that, the thesis entitled **"GST: Centre-State Relations and Tax Structure of India with Special Reference to Rajasthan",** submitted by me, for the award of the Degree of **Doctor of Philosophy (Public Administration),** to the Department of Public Administration, Faculty of Art, Education and Social Sciences, Jai Narain Vyas University, Jodhpur (Rajasthan) is a record of my work, carried out by me under the supervision and guidance of **Dr. Jagmal Singh Shekhawat**, Professor & Head, Department of Public Administration, Faculty of Art Education and Social Sciences, Jai Narain Vyas University, Jodhpur.



Dated: 01-09-2020 ***Mrs. Neelu Purohit***

DEPARTMENT OF PUBLIC ADMINISTRATION
J.N.V. UNIVERSITY
JODHPUR 342005 (Raj)

CERTIFICATE OF PLAGIARISM CHECK

1	**Name of the Research Scholar**	Neelu Purohit
2	**Course of the Study**	Ph.D. (Public Administration)
3	**Title of the Thesis**	"GST: Centre-State Relations and Tax Structure of India with Special Reference to Rajasthan",
4	**Name of the Supervisor**	Professor (Dr.) Jagmal Singh Shekhawat
5	**Department**	Department of Public Administration
6	**Acceptable Maximum Limit**	10%
7	**Percentage of Similarity of Content Identified**	1%
8	**Software Used**	TURNITIN
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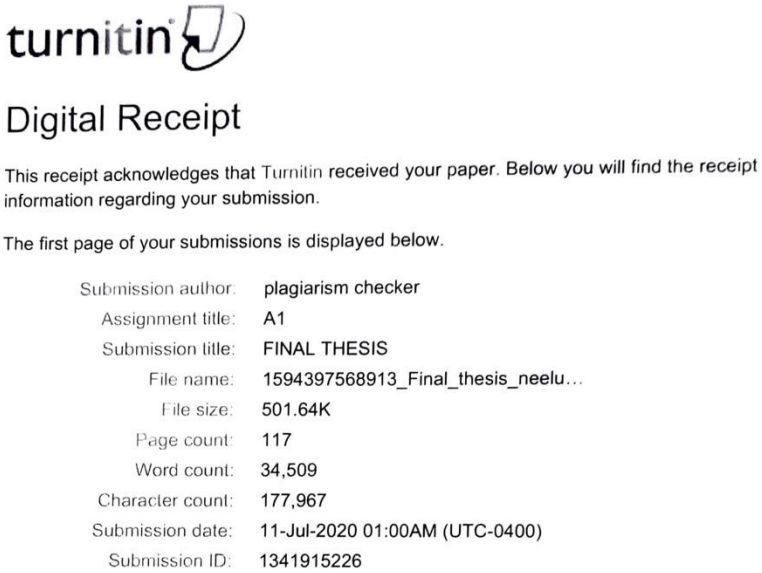

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Date:

Signature of Supervisor

Head
Department of Public Administration
Jai Narain Vyas University
JODHPUR (Raj.)

Signature of Candidate
(Neelu Purohit)

DR. JAGMAL SINGH SHEKHAWAT
Professor & Head
Department of Public Administration
Jai Narain Vyas University
Jodhpur
Mobile:+91-9414475298

CERTIFICATE

This is to certify that the thesis entitled **"GST: Centre-State Relations and Tax Structure of India with Special Reference to Rajasthan",** submitted for the award of the Degree of Doctor of Philosophy in the Department of Public Administration, Faculty of Arts Education and Social Science, Jai Narain Vyas University, Jodhpur by **Mrs. NEELU PUROHIT**, Research Scholar, embodies the results of original research work carried out under my supervision. This work has not been submitted for any other degree in India or abroad.

Date: 01.09.2020

Dr. Jagmal Singh Shekhawat
Research Supervisor
Professor & Head

JAI NARAIN VYAS UNIVERSITY, JODHPUR
(DEPARTMENT OF PUBLIC ADMINISTRATION)

CERTIFICATE

This is to Certify that Ms. Neelu Purohit in the Department of Public Administration, Jai Narain Vyas University, Jodhpur has qualified the Course-Work organized by the university in the year 2015.

This Certificate is issued in accordance with the provisions of UGC (Minimum standards and procedure for award of M.Phil/Ph.D. degree) Regulations 2009 notified in the gazette of India on 11th July, 2009.

HEAD Head
Department of Public Administration
Jai Narain Vyas University
JODHPUR (Raj.)

DATE: 08.10.2016

8/10/2016

DEAN
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Faculty of Arts, Edu.& Social Sciences
Jai Narain Vyas University
JODHPUR

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जयनारायण व्यास विश्वविद्यालय, जोधपुर

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(प्रो.जगमाल सिंह शेखावत)
Professor & Head
Department of Public Administration
J.N.V. University, Jodhpur
विभागाध्यक्ष

Prof.Jagmal Singh Shekhawat
Prof. & Head

Department of Public Administration
JN Vyas University, Jodhpur.
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Dated :: 2020

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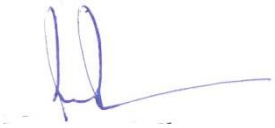
(Dr.J.S.Shekhawat)
Research Supervisor

Professor & Head
Department of Public Administration
J.N.V.University, Jodhpur

DECLARATION

I, **NEELU** hereby declare that, the thesis entitled **"GST: Centre-State Relations and Tax Structure of India with Special Reference to Rajasthan",** submitted by me, for the award of the Degree of **Doctor of Philosophy (Public Administration),** to the Department of Public Administration, Faculty of Art, Education and Social Sciences, Jai Narain Vyas University, Jodhpur (Rajasthan) is a record of my work, carried out by me under the supervision and guidance of **Dr. Jagmal Singh Shekhawat**, Professor & Head, Department of Public Administration, Faculty of Art Education and Social Sciences, Jai Narain Vyas University, Jodhpur.



Dated: 01-09-2020 ***Mrs. Neelu Purohit***

Dr. Suresh Singh Sankhla
Associate Professor
MBM Engineering College, Jodhpur

CERTIFICATE OF PLAGIARISM CHECK

1.	Name of Research Scholar	Krishan Kumar Saini
2.	Course of Study	PhD (Structural Engineering)
3.	Title of the Thesis	AN EXPERIMENTAL STUDY ON DURABILITY ASPECT OF SELF COMPACTING CONCRETE WITH RESPECT TO CARBONATION AND CHLORIDE PENETRATION
4.	Name of the Guide	Dr Suresh Singh Sankhla
5.	Name of Department	Structural Department
6.	Maximum limit of acceptance	10 %
7.	Percentage of similarity to identified content	3%
8.	Software	URKUND
9.	Date of verification	July 3, 2020

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Signature of Research scholar
Krishan Kumar Saini

Signature of Research Supervisor
Dr. Suresh Singh Sankhla
Associate Professor

(ASSOCIATE PROFESSOR)
DEPARTMENT OF STRUCTURAL ENGINEERING
FACULTY OF ENGINEERING & ARCHITECTURE
JAI NARAIN VYAS UNIVERSITY, JODHPUR (RAJ.)

JAI NARAIN VYAS UNIVERSITY, JODHPUR

(DEPARTMENT OF STRUCTURAL ENGINEERING)

CERTIFICATE

This is to certify that Mr. Krishan Kumar Saini in the Department of Structural Engineering, Jai Narain Vyas University, Jodhpur has qualified the Course-work organized by the University.

This Certificate is issued in accordance with the provisions of UGC (Minimum standards and procedure for award of M.Phil/Ph.D. degree) Regulations 2009 notified in the gazette of India on 11th July, 2009.

HEAD

Professor & Head
Department of Structural Engineering
Faculty of Engineering
J.N.V. University, JODHPUR

DEAN 28/10/17

DEAN
FACULTY OF ENGINEERING
MBM ENGINEERING COLLEGE
J. N. V. UNIVERSITY
JODHPUR

DATE: 28th October, 2017

Krishan Saini

(ASSOCIATE PROFESSOR)
DEPARTMENT OF STRUCTURAL ENGINEERING
FACULTY OF ENGINEERING & ARCHITECTURE
JAI NARAIN VYAS UNIVERSITY, JODHPUR (RAJ.)

DEPARTMENT OF STRUCTURAL ENGINEERING
FACULTY OF ENGINEERING, M.B.M. ENGINEERING COLLEGE
JAI NARAIN VYAS UNIVERSITY, JODHPUR

No. JNVU/FE/PSE/Ph.D/2020/1356 Dated: 2nd July, 2020

CERTIFICATE

This is to certify that **Mr. Krishan Kumar Saini** has qualified the Pre Ph.D. thesis presentation on **"An Experimental Study On Durability Aspects Of Self-Compacting Concrete With Respect To Carbonation And Chloride Penetration"** on 02-07-2020.

This certificate is issued in accordance with the provision of UGC (Minimum standards and procedure for award of Ph.D. degree) Regulations.

2/7/2020

(Dr. Ajay Sharma)
Professor & Head
Department of Structural Engineering
Faculty of Engineering & Architecture
Jai Narain Vyas University, JODHPUR

Professor & Head
Department of Structural Engineering
Faculty of Engineering
J.N.V. University, JODHPUR

Place: Jodhpur
Dated: 2nd July, 2020

Krishan Saini

(ASSOCIATE PROFESSOR)
DEPARTMENT OF STRUCTURAL ENGINEERING
FACULTY OF ENGINEERING & ARCHITECTURE
JAI NARAIN VYAS UNIVERSITY, JODHPUR (RAJ.)

Dr. Suresh Singh Sankhla
Associate Professor
MBM Engineering College, Jodhpur

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Subject: [Urkund] 3% similarity - sss.st@jnvu.edu.in
To: <sss.st@jnvu.edu.in>

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Signature of Research scholar
Krishan Kumar Saini

Signature of Research Supervisor
Dr. Suresh Singh Sankhla
Associate Professor

(ASSOCIATE PROFESSOR)
DEPARTMENT OF STRUCTURAL ENGINEERING
FACULTY OF ENGINEERING & ARCHITECTURE
JAI NARAIN VYAS UNIVERSITY, JODHPUR (RAJ.)

JAI NARAIN VYAS UNIVERSITY, JODHPUR

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HEAD

Professor & Head
Department of Structural Engineering
Faculty of Engineering
J.N.V. University, JODHPUR

DEAN 28/10/17

DEAN
FACULTY OF ENGINEERING
MBM ENGINEERING COLLEGE
J. N. V. UNIVERSITY
JODHPUR

DATE: 28th October, 2017

Krishan Saini

(ASSOCIATE PROFESSOR)
DEPARTMENT OF STRUCTURAL ENGINEERING
FACULTY OF ENGINEERING & ARCHITECTURE
JAI NARAIN VYAS UNIVERSITY, JODHPUR (RAJ.)

DEPARTMENT OF STRUCTURAL ENGINEERING
FACULTY OF ENGINEERING, M.B.M. ENGINEERING COLLEGE
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1. INTRODUCTION Around 75% of the land surface area on the earth is arid and semi-arid in nature (Archibold, 1995). The Thar desert has a wide coverage area of 4000 sq. km in the Western region of the Indian subcontinent. It is the ninth largest hot subtropical desert in the world. Around 85% of the Thar desert area is present in India and 15% in Pakistan, with most of the area located in Rajasthan and Gujrat states (Krishnan 1952). Indian Thar desert possesses unique and high biodiversity as compared to other subtropical deserts, containing 14.29% trees, 16.26% shrubs, 60.10% herbs, and 9.36% climbers (Charan & Sharma 2016). In addition, Indian Thar desert has various medicinal plants of high pharmaceutical value. Around 205 medicinal plants were examined by the Indian Council of Forestry Research and Education (ICFRE) (Tripathi et al. 1996). Schweinfurthia papilionacea (L.) Boiss is an important xerophytic plant of rocky and saline habitat, which was
reported to have several pharmaceutical properties, such as diuretic, antimalarial, antipyretic, antioxidant, and anticancer (Shahbaz et al. 2022). It is also useful in diabetes, typhoid and epistaxis/nose bleeding (Bhandari 1990).
All parts of the plant contain alkaloids but fruits contain more saponins as compared to other plant parts (Sabnis & Rao, 1983). Schweinfurthia papilionacea is considered as a rare or threatened plant due to over-exploitation of its habitat (Jain & Rao 1983; Groombridge & Jenkins, 1994; Ishnava 2005). In-vitro regeneration techniques were proved to be useful for conservation of the rare/threatened plants of economical and medicinal value (Bharvad & Mohan, 2012). Therefore, one of the proposed objectives of the present study involves optimization of in-vitro regeneration technique for S. papilionacea through organogenesis and/or somatic embryogenesis, for its multiplication and conservation. Thar desert has harsh climatic conditions such as water scarcity and saline/alkaline soil. Most of the shrubs and trees growing here are well adapted for various abiotic stress conditions, such as drought, salinity, and high-temperature (Caballero et al. 2003).
These xerophytes possess unique mechanism of stress tolerance at morphological, physio-biochemical, and molecular levels, which are unexplored in
the case of many desert plants (
Hasanuzzaman et al. 2013). Therefore,
it would be interesting to study the mechanism of abiotic stress tolerance in these plants

of extreme environments, which could further be used for crop improvement programs through mining of novel stress-tolerant genes. In view of the above, the current study also aims towards elucidating the mechanism of abiotic stress tolerance in S. papilionacea, and a xero-halophyte saltbush – Atriplex spp., which are well adapted to dry and saline soils. 2. REVIEW AND CURRENT STATUS OF THE PROPOSED RESEACRH Two plants of arid region are selected for the current study: Schweinfurthia papilionacea and Atriplex spp., having high medicinal value and abiotic stress tolerance, respectively. The brief account of the current status of research at National and International level for both of the selected plant species are presented in the following section: 2.1. Schweinfurthia papilionacea The genus Schweinfurthia papilionacea (L.)
is a small perennial herb belonging to the family Plantaginaceae, locally known as Nepal-nimbo or Sanipat and. It is an erect herb
with height of 30-55 cm. Leaves vary in size and shape, acute, ovate or spathulate, and hairy with very minute hairs on both sides. Flowers are pedicellate and axillary, stamens are 2 and epipetalous. Ovary is superior with axile placentation. Seeds are numerous in number, black or dark-brown in colour (
Ishnava et al. 2005). The
geographical distribution of Schweinfurthia papilionacea species is mainly confined to India (Rajasthan and Gujarat), Pakistan and Afghanistan (Hooker 1883, Cooke 1958, Bhandari 1990, Kirtikar & Basu 2001). Schweinfurthia papilionacea species were reported from
different regions such Jamnagar district of Gujrat (Malhotra & Wadhwa 1973; Shah, 1978), arid parts of Kachchh and Saurashtra (Anuradha Babu et al. 1978; Rao, 1983). This taxon was also reported from the rocky area of the west Aravalli hills of Rajasthan (Singh et al. 1991) and some taxa were examined in Jaisalmer, Rajasthan (Shetty & Singh, 1987).
This perennial herb has high medicinal values as a diuretic, antimalarial, antipyretic, antioxidant, and anticancer (Shahbaz et al. 2022) and is
also useful in diabetes as well as typhoid and epistaxis/nose bleeding (Bhandari 1990). According to Kirtikar and Basu (2001), the remedy is used to ameliorate the simultaneous dementia of Vata, pitta, and Kapha, tonic, diuretic, antipyretic, and in typhoid. All parts of the plant contain alkaloids but, stem, root, and fruits have more saponins (Sabnis & Rao 1983). One well-known alkaloid is 'Schweinfurthin' which is used in diabetes treatment. This plant has been listed as rare and threatened by World conservation monitoring
centre (WCME Cambridge 1994; Joshi et al. 2013).
An in-vitro regeneration studies would be useful for S. papilionacea
for its protection and conservation. Since this plant is mostly found in rocky, dry and saline habitat, it can be studied for its stress tolerance potential under extreme environmental conditions. Although there are several reports describing medicinal properties of S. papilionacea, there is no single report found in the literature about the tissue culture or abiotic stress responsiveness of this important desert plant. 2.2. Atriplex spp. The saltbush - Atriplex is well adapted to saline and alkaline soils of the desert, and is considered a high protein containing palatable forage shrub (McKell, 1994).). It is a xero-halophyte belonging to the Amaranthaceae family (According to the APG system), containing more than 200 species found in the subtropical and temperate regions. These species have unique adaptive mechanisms that helped them to evolve and survive under harsh conditions of arid and semi-arid regions (Khan et al. 2000; Munns, 2002). Generally, low salinity levels do not show any adverse effect on growth and development, and stimulate growth and development of Atriplex spp. (Ashby & Beadle, 1957; Chatterton & McKell, 1969; Matoh et al. 1986). But high salinity may reduce the total biomass of Atriplex spp. (Greenway, 1968; Priebe & Jager, 1978; Richardson & McKell, 1980; Aslam et al., 1986; Uchiyama, 1987; Ungar, 1996). Those plant species that easily complete their life cycle in extreme environment are the better competitors as compared to others (Tiedemann et al., 1983). Many halophytes possess salt glands on their leaves that help in excluding salt from plants' bodies (Sangam et al., 2005), whereas some halophytes are salt accumulators. A plant's ability to survive under salt stress is frequently measured by Na+ and Cl- ions concentration (Sadder et al., 2013). The K+/Na+ ratio in the cells of salt-tolerant plants is regulated by the sequestration and accumulation of salts within the cell vacuoles (Glenn et al., 1998). Atriplex spp. secrete out excessive salts from the cells through special vesiculated hairs or trichomes present on its leaves (McKell, 1994). The production and storage of osmolytes/osmoprotectants are important strategies that plants have evolved to resist stressful situations (Peel et al., 2010). Some examples of osmolytes are glycerol, mannitol, proline, sucrose, trehalose, and betaine, which support cell metabolism under stressful circumstances (Li et al., 2007; Teimouria et al., 2009). Atriplex species can accumulate inorganic and organic osmolytes in cells to maintain osmotic homeostasis under stress (Flowers, 1977). This plant represents an indispensable genetic resource in the face of a major ecosystem risk. However, it will be interesting to explore the unique mechanisms of salinity and drought resistance in this important xero- halophytic species.

3. OBJECTIVES 1) Field Survey and germplasm collection of the selected plant species. 2) Optimization of in-vitro regeneration in S. papilionacea through organogenesis/somatic embryogenesis. 3) Analysis of abiotic-stress responsiveness of the selected plant species under salinity and/or drought stress conditions. 4) Optimization of NaCl and PEG concentration (for imposing salinity and drought stress, respectively), to which plants exhibit abiotic-stress phenotype, but can survive the treatment. 5) Optimization of time duration under imposed salinity and/or drought stresses, to which plants exhibit abiotic-stress phenotype, but can survive the treatment. 6) Morphological characterization of the selected plant(s) for their responsiveness towards abiotic stress (salinity/drought). 7) Physiological and biochemical characterization of the selected plant(s) for their responsiveness towards abiotic stress (salinity/drought). 8) Molecular characterization of the selected plant(s) for their responsiveness towards abiotic stress (salinity/drought). 9) Differential expression analysis of some stress-responsive marker genes in response to abiotic stress conditions (salinity/drought) in the selected plant(s). 10) Differential expression analysis of some stress-responsive genes in different tissues of the selected plant(s).

4. EXPERIMENTAL METHODOLOGY

• The selected plant species for the proposed study: Schweinfurthia papilionacea and Atriplex spp. Following methods will be used for above mentioned studies:

4.1. Field survey and germplasm collection Field survey and collection of germplasm of the two selected plant species will be carried out from Western regions of India.

4.2 in-vitro regeneration • Optimization of in-vitro regeneration protocol for Schweinfurthia papilionacea using various explants (leaf, stem etc.), medium components, and different combinations of Plant Growth Regulators (PGRs). • Protocol standardization for the mode of regeneration via direct organogenesis and/or somatic embryogenesis.

4.3. Analysis of morphological features under stress conditions • Treatment of in vitro/ hydroponically grown seedlings with different concentrations of salt (NaCl) and/or poly-ethylene glycol (PEG), to which plants exhibit abiotic-stress phenotype, but can survive the treatment. • Phenotypic analysis of the selected plants under abiotic stresses (drought and/or salinity) conditions. (i) Root/shoot length ratio. (ii) Seedling growth rate: change in biomass (FW/DW) (iii) Seed germination potential 4.4. Physio-biochemical assays • Treatment of in vitro/ hydroponically grown seedlings with different concentrations of salt (NaCl) and/or poly-ethylene glycol (PEG), to which plants exhibit abiotic-stress phenotype, but can survive the treatment. • Physio-biochemical analysis of selected plant species under abiotic stresses (drought and/or salinity) conditions: (i) Estimation of relative electrolyte leakage (REL) under stress conditions according to Pang et al. (2010), with some modifications. (ii) Determination of Glycine betaine (GB) content under stress conditions according to Grieve & Grattan (1983), with some modifications and using the standard curve of GB. (iii) Thiobarbituric acid (TBA) test and determination of lipid peroxidation under stress conditions by measuring malondialdehyde (MDA) content according to Heath & Packer (1968), with some modifications. (iv) Determination of proline content under stress conditions according to (Bates et al. 1973), with some modifications.

4.5. Anti-oxidant enzyme activity assays • Treatment of in vitro/ hydroponically grown seedlings with different concentrations of salt (NaCl) and/or poly-ethylene glycol (PEG), to which plants exhibit abiotic-stress phenotype, but can survive the treatment. • Assays of some anti-oxidant enzyme activities in the selected plant species under abiotic stresses (drought and/or salinity) conditions: (i) Estimation of Ascorbate peroxide (APX) activity under stress conditions according to Nakano & Asada (1981), with some modifications. (ii) Estimation of Glutathione reductase (GR) activity under stress conditions according to Smith et al. (1988), with some modifications. (iii) Estimation of Nitrate reductase (NR) activity under stress conditions according to Wray & Filner (1970), with some modifications. (iv) Estimation of Catalase (CAT) activity under stress conditions according to Aebi (1984), with some modifications.

4.6 Gene expression analysis • Treatment of in vitro/hydroponically grown seedlings with different concentrations of salt (NaCl) and/or poly-ethylene glycol (PEG), to which plants exhibit abiotic-stress phenotype, but can survive the treatment. • Expression Analysis of some stress-responsive marker genes (such as CAT, APX, GR etc.) under abiotic stresses (drought and/or salinity) conditions in the selected plant(s). (i) Optimization of protocol for extraction of high-quality total RNA from the plant samples under control and stressed (drought and/or salinity) conditions. (ii) Qualitative and quantitative analysis of RNA by nanodrop and Agarose gel electrophoresis. (iii) Synthesis of cDNA from the total RNA by using reverse transcriptase RT-PCR (Jha et al. 2014). (iv) Sequence retrieval and primer designing for some stress-responsive marker genes and endogenous control in the selected plant(s), using online tools. (v) Gene expression analysis and determination of transcript levels of the selected genes in different plant tissues (leaf, stem, root etc.) and under various abiotic stress conditions (salinity/drought), using real-time qRT-PCR (Jha et al. 2012).

5. CONCLUSION In terms of ecology, economy, ethnobotany, and research perspectives, the vegetation of the Thar Desert is exceptional because it can withstand extreme environmental conditions, including extremely high temperatures (upto 50°C), saline/alkaline soil, little or no rainfall (10–50 cm). Most plants grown in this area are xerophytes and/or halophytes, having a unique stress-adaptive mechanism

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at morphological, physio-biochemical, and molecular levels, which are unexplored in case of many desert plants.

It would be interesting to explore these complex mechanisms of abiotic stress tolerance in arid region plants. These plants could be a good source of novel stress tolerance genes, to be used further in crop improvement programs. Furthermore, climate change and industrial activities are threatening important native flora of the Thar desert. In order to preserve their population, in-vitro regeneration technology may be helpful.
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1. Introduction Around 35% of the ecosystem represents deserts on the Earth's surface. Majorly of deserts are of two types- hot or dry deserts, and cold deserts. Desert ecosystems have unique vegetation due to harsh climatic and soil conditions, and physical environment. Many desert plants are becoming threatened due to the pressure of the increasing human population and changing climate, resulting in the decrease of endemic plants. Desert plants accumulate various types of secondary metabolites like alkaloids, terpenes, and many more. These secondary metabolites impart tolerance to these plants for various abiotic stress conditions in the harsh environment of the desert, and also medicinal properties. These plants are very important for the desert ecosystem as well as human welfare. Therefore, it is of utmost importance to conserve rare and endangered desert plants. For
the multiplication and conservation of economically and ecologically important xerophytes, the
in-vitro regeneration technique could be a useful approach (Pérez et al. 2015). The Thar desert has unique vegetation, comprising herbaceous plants and shrubs compared to the tree plants, grown under a scarcity of water, high temperature, saline soil, etc. Herbaceous plants easily complete their life cycle and remain dormant in adverse environmental conditions, whereas most of the shrubs and trees in
the
Thar desert are well adapted to drought, salinity, and high-temperature conditions. These xerophytes possess different mechanisms of abiotic stress tolerance at morphological, physio-biochemical, and molecular levels (Hasanuzzaman et al. 2013) which are unexplored in
the
case of many desert plants. In addition, desert plants are the major source for herbal medicines as well as pharmaceuticals, food additives, natural antioxidants, natural flavours,
and
secondary metabolites, e.g., phenolic compounds, flavonoids, nitrogen-containing compounds, etc. An important xerophytic plant Schweinfurthia papilionacea is reported to have several pharmaceutical properties. This herb has high medicinal values as a diuretic, antimalarial, antipyretic, antioxidant, and
anticancer (Shahbaz et al. 2022) and is

also useful in diabetes as well as typhoid and epistaxis/nose bleeding (Bhandari 1990). According to Kirtikar and Basu (2001), the remedy is used to ameliorate the simultaneous dementia of Vata, pitta, and Kapha, tonic, diuretic, antipyretic, and in typhoid. All parts of the plant contain alkaloids but, stem, root, and fruits have more saponins (Sabnis & Rao 1983). One well-known alkaloid is 'Schweinfurthin' which is used in diabetes treatment. This plant has been listed as rare and threatened by WCME (World conservation monitoring center, Cambridge 1994; Joshi et al. 2013). S. papilionacea is mostly found in rocky and saline habitat as well as extreme environment. Therefore, this plant can be a good source of stress-tolerant genes, to be used further for crop improvement programs. 2. In vitro regeneration Plant tissue culture was initiated by Gottlieb Haberlandt a German plant physiologist (1898) after 'cell theory' was given by Schleiden and Schwann in 1838-1839. This technique exploits the concept of "totipotency" i.e., each cell has high ability to regenerate into a whole new plant. This approach can be used for mass level production of valuable plants under aseptic lab condition. This technique has a wide range of applications like clonal propagation of plant, plant genetic improvement, production of photosynthetically efficient plants, bio-processing as well as biodiversity conservation. It is extensively used in forestry and agriculture fields. Many factors affect the regeneration of an explant, such as medium components, phytohormones (IAA/IBA/2,4D & BAP), source of explant, light intensity and temperature as well as genotype of explant (Kumar et al. 2011).
For example, explants obtained from meristematic cell of axillary bud and young part of petiole are best source for somatic embryogenesis. Recent studies on in vitro regeneration reports molecular and cellular signalling in organogenesis and embryogenesis in response to explant damaging, induced PCD, and phytohormones interaction. Some
deleterious or useful changes may occur during the plant regeneration process in vitro. One of the most common changes at the
cellular is "somaclonal" variations (Pasqual et al. 2012). 2.1 In-vitro regeneration through organogenesis A mature plant consists of many special types of cells or tissues and their organizations. Some special types of tissues like meristem, ground, vascular, epidermal as well as hypodermal tissues. consist of cells that are in uniform shape and have a particular function. Group of cells that do same functions and have same origin known as tissue. Group of tissues form an organ; such as leaves, stems, roots, flowers and many more. The process of initiation and development of an organ is called organogenesis, which is one of the most important ways to regenerate plants in-vitro. Plant apical meristematic cells of shoots and roots contain high regenerative properties. (
Bidabadi & Jain 2020). After cutting them, "dedifferentiation" and "redifferentiation" occur in the specific cells/tissues, resulting in formation of new shoots, lateral branches and roots. This process is known as organogenesis (Dinnen & Benfey 2008; Duclercq et al. 2011; Ikeuchi et al. 2016; Zhang et al. 2018), (Fig. 1), which occurs through formation of "callus", defined as "a group of cells unorganized, undifferentiated mass of cells derived from the adequate source of tissue that is cultured through in vitro conditions" (Bhatia et al. 2015). Callus redifferentiates into a particular organ primordium (Fig. 1), further developing into the desired whole plant (Bhatia et al. 2015). Even this process can make vascular connection between the explant and the newly regenerating tissues or organs (Bidabadi & Jain 2020).
2.2 In-vitro regeneration through somatic embryogenesis "

or vegetative cell" (Bhatia et al. 2015), which are 'totipotent' in nature. The embryo formed through somatic embryogenesis is known as embryoid. Somatic embryogenesis was discovered by Steward (1958) & Reinert (1959) in Daucus carota through cell suspension culture. This is also known as asexual reproduction because no fertilization takes place for embryo formation. This is one of the best techniques for
the multiplication of threatened Ecologically, and economically important plants. Somatic embryogenesis can be affected by several factors, such as explant type (leaf, bud, stem, etc.), composition of nutrient medium, and growth-promoting hormone (Bhatia et al. 2015).
Development stages involved in somatic embryogenesis are similar to zygotic embryos without fusion of gametes, but zygotic embryos have reserve food, vascular connection, and dormant stage. Somatic embryogenesis could be well suited for micropropagation of threatened or rare plant species and for their commercial production. There are two ways for somatic embryogenesis; when somatic embryos are formed without callus formation, this process is known as direct embryogenesis (
Braybrook & Harada 2008; Sánchez-Romero 2021).
Direct embryogenesis is rarely used for in vitro regeneration of plant cultivar because of less somaclonal and chimeric variations. Successful direct somatic embryogenesis leads to high percentage of genetic homogeneity among all regenerates. Therefore, plantlets produced through direct embryogenesis are morphological, physiological, biochemical, cytological and genetically similar.

Genetic homogeneity and stability of micropropagated plants can be assessed by DNA-based molecular markers,

such as random amplified polymorphic DNA (RAPD) and inter simple sequence repeat (ISSR) (

Bidabadi & Jain 2020; idabadi et al. 2010;
Martins et al. 2004). Indirect plant regeneration process has additional step of callus formation, and carried out by organogenesis or embryogenesis (Fig. 2),
finally forming the organs (Zimmerman 1993).
The whole process depends on the source of explant, medium composition, plant growth promoters, explant genotype, carbon source and gelling agent, along with physical factors such as light duration or intensity, temperature as well as humidity. Through this process, plantlets can be regenerated from shoot apex, and various other mature somatic tissues, such as stem with single bud, pollen, and protoplasts (Chupeau et al. 2013; Maraschin
et al. 2005). Protoplasts is a without cell wall structure and has ability to redevelop a new cell wall, when we keep it on suitable media, further regenerating into complete plantlet. Protoplast culture could also be a suitable technique for crop improvement through genome editing (Abdallah et al. 2015;
Roest & Gilissen, 1989).
2.3
Somaclonal variations Some crop plants are difficult to breed due to their poor genetic basis, which leads to low productivity, less
vigor, susceptibility to
stresses, less viability, etc. Therefore, somaclonal variations could be a useful additional option for the breeders (Krishna 2016). “Somaclonal variations are defined as genetic or epigenetic changes that arise in vitro between clonal regenerants and their corresponding donor plants” (Leva & Rinaldi 2017). In this process, genetic/cytogenetic changes and alterations in specific nucleotide sequences of DNA occur by mutation. Another major reason for somaclonal variations is epigenetic change, which includes any process that alters gene activity without changing the specific nucleotide sequence of DNA. These modifications can be stable and transmitted from one generation to another generation (Can et al. 2021). Many types of epigenetic modifications (
like on histone) have been identified to
date: methylation (–CH3), acetylation (C2H3O), phosphorylation (PO43-), ubiquitylation (Ub), and Sumoylation (addition of a “Small Ubiquitin-like modifier protein/sumo protein”) (Edward & Hong 2013; Vanzan et al. 2017). The occurrence of somaclonal variation in tissue culture has a negative effect on the rapid production of clonal plants of elite cultivars but may promote the production of novel horticultural crop genotypes. An improved understanding of the mechanisms of variation in tissue culture, specifically epigenetic variation, maybe a potential tool in producing cultivars adapted to meet the growing demand for food. Somaclonal variations
have been used for large-scale micropropagation of various horticultural species, vegetables and fruits crops (Table 1) in a short period of time (Grosser et al. 2015). Various approaches are used for screening of offsprings regenerated in vitro for their genetic fidelity, including phenotypic, physio-biochemical and molecular approaches (Lavania et al .2015).
3.
Abiotic stress in plants “Any unfavorable condition or substance that affects or blocks a plant metabolism, growth or development is regarded as stress” (Lichtenthaler 1998). There are two main kinds of stresses in
the
plant kingdom: one is abiotic stress such as heat, cold, drought, salt, flooding, metals, etc., and another is biotic stress such as pathogen, insect, herbivore, etc. (Fig. 3). In abiotic stress non-living factors (temperature, water, salt, heavy metals, etc.) exert
a
negative impact on the plants, whereas in biotic stress negative impact on plants is due to living factors (fungi, bacteria, oomycetes, nematodes, herbivores, etc.) in a specific environment (Peleg &Eduardo 2012) Nowadays climate change (increasing temperature, melting of glaciers, flooding, etc.) has become a major problem for
the
agricultural sector as well as vegetation (Rajput et al. 2021), (Fig. 3). Plants are sessile in nature, with no choice to escape from unfavourable environment. Therefore, they develop various biochemical and physiological strategies in order to cope up with stress conditions and protect themselves (Gull et al. 2019). In stress condition, plants stop vegetative growth and alter various metabolic as well as signal transductions pathways. Therefore, plants experience maximum energy loss in stress condition, ultimate decreasing the productivity or yields.

3.1 Cellular and molecular responses against abiotic stresses Various abiotic stresses such as drought, high salinity, and cold significantly influence plant growth and productivity in adverse environmental conditions all over the world. Abiotic stress responses in plants depends on phytogeographical factors like physical environments, edaphic factors etc. Therefore, different phytogeographical area's vegetation respond to abiotic stress as well as biotic stress in a unique manner. Generally, desert plants are highly adapted to salt, drought, and high temperature conditions. In the following section, we have presented a brief account of plant response mechanisms at morphological, physiological, biochemical and molecular levels under these stresses (Hasegawa et al. 2000) (Fig. 4).

3.2 Salt stress response mechanisms in plants Salinity is a major problem over all the world because it severely limits the plant growth and development of food crops. Around < 45 hectares (20%) cultivated land is affected from salinity stress. Glycophytes cannot growth in saline area but xero-halophytes are adaptive to salt can easily grow and survive under high salinity. But majority of crop plants belongs to glycophytes group, posing a global threat to food security for the world's continuously increasing population (Singh & Flowers, 2010). Plants shows a variety of responses to salt stress at morphological, physio-biochemical and molecular level (Fig. 5). Morphological responses include leaf rolling, burning of leaf and reduced plant growth. Physiological responses include reduced water content, stomal closure, reduced photosynthesis, and biochemical changes such as accumulation of ROS, high level of Na+ ions and altered metabolism. Molecular responses include altered expression of various signalling pathways, expression of regulatory & functional genes as well as altered protein profile (
Jajic et al. 2015),(
Fig. 5).

3.3 Importance of abiotic stress tolerant plants Major crops plants are susceptible to abiotic stress (drought, salt, high temperature, cold, radiation, flood etc.), while some plants can tolerate these stresses. We can do comparative expression profiling of their genomes (through transcriptomics or proteomics), and find out the candidate genes involved in stress tolerance. These genes can be further used for manipulating genomes of the sensitive crop plants by generation of transgenic plants (Jha, 2019). At present, most of the studies related to abiotic stress response were done on model plant Arabidopsis. Distinct functions of the Abscisic acid (ABA) response ABF/AREBs were reported in Arabidopsis (Choi et al. 2000; Finkelstein & Lynch 2000; Kim et al. 2004). During drought condition expression of AREB regulates the stomatal closure and ultimately decrease the water loss (Fujita et al. 2005; Wang and Song 2008; Hsieh et al. 2010). Overexpression of OsbZIP23, OsbZIP72 and OsAREB1 genes in Oryza sativa conferred ABA sensitivity and drought stress tolerance (Xiang et al. 2008; Lu et al. 2009; Jin et al. 2010). However, functions of these genes remain unclear in Glycine max L.

Some transcription factor genes, such as GmbZIP44, GmbZIP62 and GmbZIP78, and GmbZIP1 were isolated from Glycine max, and overexpression of GmbZIP1 gene triggered the stomata closure, accumulation of large amounts of osmoprotectants
and reduced the water loss during drought and high salt stress conditions, as well as under ABA phytohormone (Liao et al. 2008). Overexpression of GmbZIP1 gene in transgenic Arabidopsis thaliana and Nicotiana tabacum enhanced the tolerance for drought, salt and cold stresses. Chinese wheat variety was improved under stress conditions (salt and drought) by overexpression of GmbZIP1 gene, and this gene did not cause growth retardation of Chinese wheat crop (Gao et al. 2011). In this way, the genes identified from stress-tolerant plants could be used to improve growth and productivity of crops and commercial plants under abiotic stress conditions.

4. Schweinfurthia papilionacea: A rare and medicinal plant of the Thar desert

Schweinfurthia papilionacea (L.) Boiss. (local name: Sannipat/Sanipat/Nepal-nimbo) is a perennial herb belonging to the family plantaginaceae (Bhandari et al. 1990). It is a small erect, glabrous herb. The
geographical distribution of this species is mainly confined to Afghanistan, Pakistan, (Balochistan and Sind regions), and India (Gujarat and Rajasthan) (Hooker 1883; Cooke 1958; Bhandari 1990; Kirtikar & Basu 2001). In India this species was reported
in
Jamnagar district (Malhotra and Wadhwa 1973), arid parts of Kachchh and Saurashtra, Gujarat (Shah 1978, Rao 1983, Anuradha Babu et al. 1978). Shah (1978) reported that this species is 'not common' in Gujrat. Singh et al. (1991).

An in-vitro regeneration studies would be useful for S. papilionacea, since the plant has become threatened due to over-exploitation of its habitat (Ishnava, 2005). Therefore, it could be protected through in vitro regeneration techniques, like organogenesis and/or embryogenesis (Bharvad & Mohan, 2012). In addition, this plant can be studied for its abiotic stress tolerance potential under drought and salt stress conditions.

5. Conclusion Desert plants are unique in ecological, economical, ethnobotanical and research perspectives because they grow in very harsh conditions, such as very high temperature (40-50°C), saline soil, low rainfall (10-50 cm) and drought, and well adapted to those stresses at morphological, physio-biochemical and molecular levels. It would be interesting to explore the complex mechanism of abiotic stress tolerance in these plants, which is a multigenic traits. Furthermore, many valuable native plants of Thar desert are threatened due to problems of climate change and anthropogenic activity. Therefore, in-vitro regeneration technique could be useful to conserve their population.

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such as random amplified polymorphic DNA (RAPD) and
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