

**ASSESSMENT OF CONSUMER KNOWLEDGE, PERCEPTION,
PRACTICES TOWARDS FORTIFIED FOODS AND THEIR
NUTRIENT CONTRIBUTION**

**QksVhZQkbM [kk] inkFkksZa ds izfr
miHkksDrkvksa dk Kku] izR;{kcks/k] izFkk,;
,oa muds iks"kd ;ksxnku dk vkdyu**

MISS BHAVYA PANDE

Thesis

MASTERS OF SCIENCE (COMMUNITY SCIENCE)

IN

(Food Science and Nutrition)



2019

**DEPARTMENT OF FOOD SCIENCE AND NUTRITION
COLLEGE OF COMMUNITY AND APPLIED SCIENCES, UDAIPUR**

**MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND
TECHNOLOGY, UDAIPUR (RAJASTHAN)**

**ASSESSMENT OF CONSUMER KNOWLEDGE, PERCEPTION,
PRACTICES TOWARDS FORTIFIED FOODS AND THEIR
NUTRIENT CONTRIBUTION**

**QksVhZQkbM [kk] inkFkksZa ds izfr
miHkksDrkvksa dk Kku] izR;{kcks/k] izFkk,i
,oa muds iks"kd ;ksxnku dk vkdyu**

A

THESIS

SUBMITTED TO THE

MAHARANA PRATAP UNIVERSITY OF

AGRICULTURE AND TECHNOLOGY, UDAIPUR

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR

The Degree of

MASTER OF SCIENCE (COMMUNITY SCIENCE)

(Food Science and Nutrition)

By

Miss Bhavya Pande

2019

**MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND
TECHNOLOGY**

**COLLEGE OF COMMUNITY AND APPLIED SCIENCES,
UDAIPUR**

CERTIFICATE – I

Date:

This is to certify that **Miss Bhavya Pande** had successfully completed the oral Comprehensive Examination held on.....as required under the regulation for **Master's Degree**.

Dr. Sarla Lakhawat

Associate Professor & Head

Department of Food Science and Nutrition,
College of Community and Applied Sciences,
MPUAT, Udaipur

**MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND
TECHNOLOGY**

**COLLEGE OF COMMUNITY AND APPLIED SCIENCES,
UDAIPUR**

CERTIFICATE – II

Date:

This is to certify that this thesis entitled “**Assessment of Consumer Knowledge Perception, Practices Towards Fortified Foods and their Nutrient Contribution**” submitted for the degree of **Master of Science** in the subject of **Food Science and Nutrition** submitted to **Maharana Pratap University of Agriculture and Technology, Udaipur** embodies bonafide research work carried out by **Miss Bhavya Pande** under my guidance and supervision and that no part of this thesis has been submitted for any other degree. The assistance and help received during the course of investigation has been fully acknowledged. The draft of the thesis was also approved by the advisory committee on

Dr. Sarla Lakhawat

Associate Professor and Head
Department of Food Science and Nutrition,
College of Community and Applied Sciences,
MPUAT, Udaipur.

Dr. Sarla Lakhawat

Major Advisor

Prof. Ritu Singhvi

Dean,
College of Community and Applied Sciences, Udaipur.

**MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND
TECHNOLOGY,
COLLEGE OF COMMUNITY AND APPLIED SCIENCES, UDAIPUR**

CERTIFICATE – III

Date:

This is to certify that this thesis entitled “**Assessment of Consumer Knowledge Perception, Practices Towards Fortified Foods and their Nutrient Contribution**” submitted by **Miss Bhavya Pande** to Maharana Pratap University of Agriculture and Technology, Udaipur in partial fulfilment of the requirement for the degree of **Master of Science** in the subject of **Food Science and Nutrition** after recommendation by the external examiner was defended by the candidate before the following members of the examination committee. The performance of the candidate in oral examination held on..... was found satisfactory. We therefore, recommend that the thesis be approved.

Dr.Sarla Lakhawat
Major Advisor

Dr. Renu Mogra
Member

Ms. Seema Dwivedi
Member

Dr. Dhriti Solanki
DRI, Member

Dr. Sarla Lakhawat
Head
Department of Food Science
and Nutrition
College of Community and
Applied Sciences,

Prof. Ritu Singhvi
Dean
College of Community and Applied
Sciences, Udaipur

APPROVED
DIRECTOR RESIDENT INSTRUCTION
MPUAT, UDAIPUR

**MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND
TECHNOLOGY,
COLLEGE OF COMMUNITY AND APPLIED SCIENCES, UDAIPUR**

CERTIFICATE – IV

Date:

This is to certify that **Miss Bhavya Pande** student of the **Food Science and Nutrition** College of Community and Applied Sciences has made all correction/ modification in the thesis entitled “**Assessment of Consumer Knowledge Perception, Practices Towards Fortified Foods and their Nutrient Contribution**” which was suggested by the external examiner and the advisory committee in the oral examination held on..... The final copies of the thesis duly bound and corrected were submitted on.....are enclosed herewith for approval.

Dr. Sarla Lakhawat

Major Advisor

Enclosed one original and three copies of bound thesis, forwarded to the Director Resident Instruction, Maharana Pratap University of Agriculture and Technology, Udaipur through the Dean, College of Community and Applied Sciences, Udaipur.

Dr. Sarla Lakhawat

Head of the Department

Prof. Ritu Singhvi

Dean,

College Community and Applied Sciences,

Udaipur



**DEPARTMENT OF FOOD SCIENCE AND NUTRITION
COLLEGE OF COMMUNITY AND APPLIED SCIENCES, UDAIPUR
MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND
TECHNOLOGY, UDAIPUR**

CERTIFICATE – V

Date:.....

This is to certify that **Miss Bhavya Pande** (M.Sc. Scholar) has worked under me on “**Assessment of Consumer Knowledge Perception, Practices Towards Fortified Foods and their Nutrient Contribution**”.

1. I have monitored her research work.
2. Myself and the scholar were in contact with the committee members and the research work was reviewed regularly.
3. The advisory committee members have gone through M.Sc. thesis critically and made correction as per requirement.

Dr. Sarla Lakhawat
Major Advisor

ACKNOWLEDGMENT

*I express my heartiest devotion to The **Almighty** for his graceful blessing at every step without which nothing could have been accomplished.*

*It is indeed gratifying to have the privilege to express my deep sense of gratitude and appreciation to my esteemed guide **Dr. Sarla Lakhawat**, Associate Professor and Head, Department of Food Science and Nutrition, College of Community and Applied Sciences, Maharana Pratap University of Agriculture and Technology, Udaipur for her unique guidance, constant endeavour, keen interest and incessant encouragement, ever helping attitude and amicable behaviour during the course of this investigation, which brought this surmount task to success. For all this kind consideration I am beholden to her in a special manner and words fail to convey my feelings of respect, love, and regard for her.*

*I hereby take the golden opportunity to express my heartfelt gratitude and sincere thanks to **Dr. Ritu Singhvi**, Professor, and Dean, College of Community and Applied Sciences, Maharana Pratap University of Agriculture and Technology, Udaipur for providing all the required facilities for the investigation and completion of the research.*

*With deep veneration, I express my indebtedness to my advisory committee, **Dr. Renu Mogra**, Professor, Department of Food Science and Nutrition, **Ms. Seema Dwivedi**, Associate Professor, and Head, Department of Resource Management and Consumer Sciences and DRI nominee, **Dr. Dhriti Solanki**, Professor, Department of Extension Education and Communication Management and the Directorate of Research and Instructions (DRI) **Dr. Vandana Kaushik**, Professor, Associate Professor and Head, Department of Resource Management and Consumer Sciences for their benevolent cooperation during the execution of this investigation.*

*Words are the poor substitute to express my gratitude towards my parents. The personal attention and blessing and care provided by them gave strength to move forward towards the completion of this research. I am indeed thankful to my mother **Mrs. Prema Pande** and my father **Mr. P. C. Pande** for supporting and applauding my academic efforts constantly and always being a beacon of inspiration and tower of strength and encouragement for me. No language can express my feelings in printed*

*words of my loving sister **Divya Pande** who enthusiastically heartened me in the most crucial hours and for what she always been to me.*

*I am affectionate to my friends **Divya, Akanksha, Divya, Anupriya, Kawita** my beloved junior **Anushka** and seniors **Vishakha ma'am, Christina ma'am and Anjali ma'am** who were a constant source of the help of all kinds and made my task so much lighter by their pleasant and gracious company.*

I would like to thank all the staff members of the Department of Food Science and Nutrition, College of Community and Applied Sciences, for all their support.

Still, there are many well-wishers, friends, who rendered indispensable help to complete this academic endeavor. I have a deep sense of reverence for all of them.

Date

Place: Udaipur

(Bhavya Pande)

CONTENTS

S. No.	Contents	Page No.
1	Introduction	1-5
2	Review of literature	6-18
2.1	Inadequacy of micronutrient	
2.2	Studies on efficacy of fortified foods	
2.3	Nutrient contribution	
2.4	Studies on consumer knowledge, perception, and practices towards fortified foods	
3	Methodology	19-29
3.1	Locale of study	
3.2	Sample and its selection	
3.3	Research tool and its description	
3.4	Procedure of data collection	
3.5	Development of folder	
3.6	Data analysis	
4	Results and its discussion	30-56
4.1	Background information of the consumer	
4.2	Knowledge towards fortified foods	
4.3	Perception of respondents towards fortified foods	
4.4	Existing practices of consumer regarding consumption of fortified foods.	
4.5	Contribution of nutrient through fortified foods.	
4.6	Development of Folder on Importance of Fortified Foods	
5	Summary and conclusion	57-61
6	Bibliography	62-69
7	Abstract (English and Hindi)	70-71
8	Appendices	i-xv

LIST OF TABLES

S. No.	Title	Page No.
3.1	Categorisation of the consumers based on the age	21
3.2	Categorisation of the consumers based on the religion	21
3.3	Categorisation of the consumers based on the caste	21
3.4	Categorisation of the consumers based on the education qualification	21
3.5	Categorisation of the consumers based on the occupation	22
3.6	Categorisation of the consumers based on the marital status	22
3.7	Categorisation of the respondents on the basis of family type	22
3.8	Categorisation of the respondents based on family monthly income	22
3.9	Categorisation of the respondents on the basis of their food habits	23
3.10	Categorisation of the respondents based on the health problems	23
3.11	Distribution of scores to assess knowledge	24
3.12	Interpretation of scores to assess knowledge level	24
3.13	Sections of Perception Statements	25
3.15	ANOVA for one way classification	28
4.1	Background information of the consumers	32
4.2	Knowledge level of consumers	33
4.3	Knowledge of consumers regarding fortified foods	34
4.4	Knowledge of consumers regarding various fortificant	36
4.5	Knowledge of consumers regarding micronutrients	37
4.6	Knowledge of consumer regarding micronutrients deficiencies	38
4.7	Comparison of consumer knowledge among different age groups and education qualification using ANOVA	40
4.8	Consumers perception of fortified food regarding nutrition and health	42

4.9	Consumers perception towards fortified regarding safety and risks	43
4.10	Consumer perception regarding consumption of fortified foods	44
4.11	Consumers perception of fortified foods when compared with other foods	45
4.12	Factors considered while purchasing and not purchasing fortified foods	47
4.13	Label reading practices of respondents	47
4.14	Type of information checked by the consumers on ingredient panel	48
4.15	Source of information about fortified food products	48
4.16	Recommended promotion means of fortified foods by the consumers	49
4.17	Preferred brands of fortified food products	49
4.18	Frequency of consumption of fortified foods	51
4.19	Nutrient contribution of fortified foods	55
4.20	Mean scores given by experts on developed folder	56

LIST OF FIGURES

S. No.	Title	Page No.
3.1	Selection of respondents	20
4.1	Distribution of consumers by knowledge level	33
4.2	Consumers perception regarding nutrition and health aspect of fortified foods	46
4.3	Consumers perception regarding safety and risks aspect of fortified foods	46
4.4	Fortified food frequency	51

LIST OF APPENDICES

S. No.	Title	Page No.
1	Background information proforma.	i
2	Knowledge of consumer towards fortified foods.	ii
3	Perception of consumer towers fortified foods.	vi
4	Existing practices of consumer regarding consumption of fortified foods.	viii
5	List of Super markets in Udaipur city.	xiii
6	Evaluation sheet of folder on importance of fortified foods.	xiv
7	Folder on importance of fortified foods.	-
8	Statistical values used in ANOVA	xv

INTRODUCTION

Widespread micronutrients deficiency is a significant public health problem which adversely affects the nation's productivity. Across the world, more than 2 billion people suffer from vitamin and mineral deficiencies that is the one-third the population of the entire world (WHO, 2000). As per the National Family and Health Survey (NFHS) 4, over 70 per cent of people in India still consume less than half of their Recommended Dietary Allowance (RDA) of micronutrients. The reason could be a lack of consumption of a balanced diet, faulty cooking practices, diseases, low socio-economic background, lack of knowledge, etc. These people may not look hungry or malnourished but they are lacking the crucial vitamins and minerals needed to live a fully active lifestyle. For instance deficiency of iron makes a person lethargic and unable to perform efficiently in the workplace. Insufficient Vitamin A weakens the immune system and can lead to blindness, pregnant women with severe iodine deficiency can give birth to children with permanent lower IQ and insufficient folate is linked with the higher risks of birth defects like Neural Tube Defects, a in turn hindering human development. The World Bank estimates that the countries can lose between 2-3 per cent GDP due to micronutrients deficiencies.

Thus, malnutrition becomes a forerunner of illness. There are many strategies to combat malnutrition, food fortification is one such strategy to eradicate this hidden hunger which is low-cost, convenient and effective. It is the process of adding vitamins and minerals in minute quantities to commonly consumed food. Food fortification has been defined as the inclusion of one or more essential nutrients to a food, whether or not it is normally contained in it, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population (FAO, 1996).

It has been practiced well over for a century in the developed world where it helped to eradicate many diseases that are no longer public health threats today, like Goitre, Beri Beri and Pellagra. Adding iodine to salt started simultaneously in the USA and Switzerland as early as 1912. It's not a new idea in India either, Vanaspati has been fortified with vitamin A since 1953 and from last six decades, fortification of salt with iodine has been practiced in the country. Today food fortification continues to be highly relevant especially in the developing world where people with

low incomes do not have necessary means to afford a very diet full of fruits, vegetables, meat and dairy to meet their daily nutritional needs.

It is a complementary strategy and not a substitution of balanced or diversified diets to address malnutrition. Dietary diversification is indeed the best choice but in the current scenario it may be difficult to achieve by everyone, therefore a more universal approach is needed to discuss the issue. It only bridges the gap between the need and actual consumption of required micronutrients through food (WHO and FAO, 2006) as they fulfil 30-50 percent of daily requirements of micronutrients.

In India, fortification of staple foods, oil, salt, and condiments is an effective means of addressing micronutrient deficiencies in the children and adult population as these are consumed daily and by all the sections of the population thus making them the ideal vehicle for food fortification. Vitamins and minerals are added to staple foods and condiments at the normal processing stage such as wheat and maize milling, vegetable oil refining, salt grinding, and condiments production.

It is of different types, adding micronutrients in foods that are widely consumed by the general population is known as mass fortification, to fortify foods for a specific population, such as supplementary foods for young children or rations for poor populations is known as targeted fortification and to allow food manufacturers or brands to voluntarily fortify foods available in the market is called market-driven fortification or voluntary fortification. (WHO and FAO, 2006). Government-driven mandatory fortification (large-scale) works better than voluntary to reach marginal populations. Food Safety and Standards Authority of India (FSSAI) has operationalised fortification standards for 5 different foods and launched Food Fortification Resource Centre (FFRC) with an objective to promote fortified foods with a logo of +F and aware people about its health benefits. The increment cost of these ranges from 7 paise to 2 rupees roughly, which is very much affordable to the general mass.

Edible Double Fortified Salt (DFS) is now all set to play an important role in population. Iodine Deficiency Disorders (IID) and Iron Deficiency Anemia (IDA) have been two major public health problems in the country. As per the data of NHFS-4 India, 53 per cent and 56 per cent of women age 15-49 years and children of age 6-59 months are anaemic. Introduction of DFS in the diet helps to cure these deficiency

diseases. The formulations are planned to provide 100 per cent of daily dietary iodine requirement, and 30 to 60 per cent of the daily dietary iron requirement.

Edible vegetable oil is an important component to cook food and adds taste to it. Palm oil, rice bran oil, sunflower oil, soybean oil, olive oil and groundnut oil are some examples of commonly consumed oil. The vegetable oil seeds are subjected to severe treatments such as high temperature, high pressure and bleaching with the chemical absorbent for the production of the oil. Excess pressure and temperature destroys the essential nutrients that are naturally present in it such as vitamin A and E. Thus, fortification in the edible oil with essential vitamins restores the goodness of vegetable oil. Vitamin D also known as the sunshine vitamin is a very critical nutrient that is predominately synthesized by the body, as the dietary sources for the nutrient are very limited, oil fortified with vitamin D serves as an effective dietary source. Vitamin D is essential to maintain optimum bone health similarly vitamin A is required for healthy eyesight and Vitamin E for good skin health. Fortified oil is known to provide 25-30 per cent of the recommended dietary allowances for vitamins A and D.

Another food group that witnessed fortification is milk. One cannot even imagine a healthy diet without milk. It is nature's nearly complete food consisting of all the essential nutrients needed for one well-being. Benefits of fortifying milk with Vitamin A and D includes prevention of deficiency diseases like night blindness and osteoporosis and ability to reach out a significant proportion of population globally, so the acceptance of dairy products among people is high.

Rice is consumed by half of the world's population. Around 65 per cent of Indians consume rice as a staple. It is low in micronutrients once milled, fortifying it with vitamins and minerals could improve the lives of millions of consumers who are suffering from hidden hunger. Premixes of vitamins and minerals are applied either through extrusion, coating or dusting processes. The taste and appearance of the fortified kernel are just like regular rice. In India rice is generally fortified with iron, folic acid and vitamin B12, additionally, it may also be fortified with zinc, vitamin A, thiamine, riboflavin, niacin and pyridoxine either singly or in combination.

Nowadays there is an increasing trend of consuming processed or convenience food in a regular manner around the world. Due to industrialization and the food chain

becoming longer, people today are further away from farms than ever before and processed foods are now replacing a lot of traditional food because of convenience. Fortification of processed foods will help in improving the nutritional content of these items as well as help in improving the nutritional status of the large population. The food authority has drafted the standards which include fortification of cereal and cereal products like breakfast cereals, pasta and noodles, and bakery products like bread, biscuits, rusks, buns with added iron, folic acid, and Vitamin B12, they may be fortified with zinc, vitamin A, riboflavin, niacin and pyridoxine. In addition, fruit juices shall be fortified with vitamin C (FSSAI, 2017).

Now the consumers are becoming more conscious towards diet and health and hence are becoming more motivated to take care of their health by way of consuming healthier food. Increased health consciousness and changes in lifestyle, coupled with awareness about the benefits associated with health and wellness, food have led to significant changes in consumer behavior towards healthy food consumption in the recent years (Quah *et al.* 2009).

JUSTIFICATION OF THE STUDY

Adding value to staple food or in other words food fortification is a grossly under-utilized strategy in the developing countries due to lack of awareness while there are many parts of the world which have been quite successful in implementing food fortification programmes like European countries and USA. Even today a major population of the county is facing health challenges. The study was designed to understand how consumers are aware of food fortification in terms of meaning of micronutrients as used in food fortification, benefits of consuming fortified foods, types of staple foods fortified with micronutrients, benefits of food fortification and health benefits of important micronutrients used in food fortification

People generally have a false perception of fortified foods, that they are synthetic, expensive, genetically modified, unsafe, etc. The fact that it is cheap makes it feasible to improve nutrient intake relatively quickly and at scale. Results can only be positive when people have correct knowledge about fortification. Thus creating awareness is very crucial. There are two sides of creating awareness one is towards the consumer that fortified food is good for them and second is making industries aware that it is

possible to fortify food and be the agent of change or be the carriers of nutritious food to the consumer as they have large distribution channels.

Consumers are the king thus assessing their behavior towards fortified food is an important aspect. Therefore the present research is planned to access the consumer knowledge, perception, and practices towards fortified foods and the amount of nutrients each fortified food is contributing to a daily diet of a consumer. In the long run, if we are really building on the capital of our population, it is important that our people stays healthy and therefore it is crucial that people should have knowledge about food fortification. Thus, the findings of the study will provide information about the knowledge level and their existing practices. Thus, by creating demand which in turn scale up the production of fortified foods and successively help in combating micronutrient deficiencies.

OBJECTIVES

1. To assess consumer knowledge and perception regarding fortified foods.
2. To find out existing practices of consumers regarding the consumption of fortified foods.
3. To assess the contribution of nutrients through fortified foods.
4. To develop information material on Fortified Foods.

DELIMITATIONS OF THE STUDY

The study will be limited to:

1. Consumers residing within the Udaipur city, Rajasthan.
2. Literate female consumers belonging to 25 and above years of age.

REVIEW OF LITERATURE

One of the simplest ways of economizing efforts in any inquiry is to review and build upon the work already done by others. The term review of literature is the summary of the previously published research works by studying books, journals, articles, dissertations or any other sources of information that are relevant to the research under investigation. Reviewing previously published works helps to gather ideas or information and improves understanding related to the topic, it helps to keep up to date with the current trends or major findings related to the interests and to develop new research questions. In this chapter relevant literature having a direct or indirect bearing on the present investigation has been scanned and organised into the following sections:

2.1. Inadequacy of micronutrients

2.2. Studies on the efficacy of fortified foods

2.3. Nutrient contribution

2.6. Studies on consumer knowledge, perception, and practices towards fortified foods

2.1. INADEQUACY OF MICRONUTRIENTS

This section will reflect the inadequacies of micronutrients which will justify the consumption of fortified foods as a preventive measure for their control.

Singh (2009) investigated a study on women of Rajasthan to assess the micronutrient deficiency status on 1193 women. Analysis of dietary intake revealed that anemia was higher among pregnant and lactating women (80.7%). Dietary intake of iron (63%) and folic acid (43%) as per the RDA were insufficient in pregnant women and lactating women when compared to controls (4.1%). Deficiency of Vitamin A was observed to be higher among pregnant women (8.8 %). A very high percentage of women (80.80%) consumed salt, containing an inadequate amount of iodine.

As per National Family Health Survey-4 (2015-16), public health concerns like Iron deficiency Anaemia is still prevalent in over 50 per cent of women (15-45 years)

and children under 5 years of age. Almost 62 per cent of the Indian population has low serum blood levels of vitamin A and vitamin D (50-94%). Disadvantageous outcomes like stunting, increased sensitivity to infectious diseases, physical disability, cognitive losses, blindness, and premature mortality are caused because of micronutrient deficiency.

A research was carried out by Agrawal (2015) on diet and nutrient intakes in urban women (35-70 years) of Rajasthan. The average intake of foods and nutrients were recorded using a food frequency questionnaire and was compared with RDA. Results showed that average cereal, pulse, fruits, and vegetable intakes were below the recommended. The dietary iron intake of the participants was 10.39 ± 3.11 mg/day offering to 50–57 per cent of the RDA. Folate consumption was 44.19 ± 14.51 mg/day. Vitamin C consumption falls as the age advances from 52.80 ± 23.62 to 35.07 ± 14.63 mg/day, which may be due to the reduced consumption of fruits and vegetables among aging participants.

Tak and Wadhawan (2016) reported a study to assess dietary micronutrient deficiency among 120 adolescent girls (13-18 years). Micronutrient intakes were calculated by one day 24-hour dietary recall method. Iron was contributing to only about 36.08 per cent, 37.15 per cent and 45.82 per cent of RDA in the age group of 13-15, 16-17 and 18 years respectively. The dietary intake of zinc was found to be 36.39 per cent and 46.44 per cent of RDA in the age group of 16-17 years and 18 years, respectively, whereas carotene intake in the age group of 13-15 years and 16-17 years was 22.43 per cent and 29.05 per cent of RDA. Intake of dietary folic acid was found to be lowest (0.48% and 0.44%) among adolescent girls in the age group of 13-15 years and 18 years. Therefore, none of the age group was meeting 100% RDA requirement of nutrients.

India's urban population, which constitutes about more than 30 per cent, consumes very low amounts of different food groups that are required to stay healthy. NNMB Brief Report on Urban Nutrition (2017) of India states that the average consumption of nutrients was inadequate among urban adults (men and women). The average intake of the micronutrients like Iron (77.6 %,) Calcium (67%), Thiamine (83.3%) and Niacin (61.3%) was seen to be below the RDA. Whereas the intake of Vitamin A (22.8%) and Riboflavin (50%) were very much insufficient. The intake of vitamin C (128.3%) and total Folic acid (101%) were meeting the RDA.

Shalini *et al.* (2018) reported a study to assess the micronutrients insufficiency among 300 apparently healthy urban adults of Hyderabad city. Haemoglobin, ferritin, folate, and vitamin B12 in plasma was determined. Dietary intakes was assessed by three 24-hour dietary recalls. These results indicate a higher incidence of micronutrient deficiencies in women namely, the occurrence of anaemia (30%), iron deficiency (ID, 23%) and iron deficiency anaemia (IDA, 14.3%) and folate deficiency (32%). Vitamin B 12 deficiency differ by both age and gender (35.5 %).

2.2. EFFICACY OF FORTIFIED FOODS

This section will point out the effectiveness of fortified foods in improving nutrient intakes and preventing nutrient deficiencies in the population.

A research was done to compare the effect of double fortified salt (DFS) prepared by using two methods, one fortifying iron in the form of ferric pyrophosphate (MGFePP) and the other with iron as encapsulated ferrous fumarate (EFF) - with the efficacy of iodized salt (IS) in schoolchildren of age 5- 15 years (n = 458) in rural southern India. The intervention was conducted into 3 groups to receive IS or DFS with iron as MGFePP or EFF, both at 2 mg/g salt. Results revealed that iron levels in blood improved significantly in the 2 groups. The incidence of anaemia decreased from 16.8 to 7.7 per cent in the MGFePP group and from 15.1 to 5.0 percent in the EFF group after 10 months (Andersson *et al.* 2008).

As per Flour Fortification Initiative Report (2012), flour fortification program was launched in Bahrain in 2001 and requires the obligatory inclusion of iron and folate to wheat flour, the data shows significant declines in anaemia among pregnant women and in the prevalence of Neural Tube Birth Defects (NTD). Anaemia among pregnant women declined from 40 per cent in 1996 to 23 per cent in 2012. The prevalence of NTD dropped from 2.6 per 1000 live births to 0.9 per 1000 live births.

In a school feeding trial on 6 to 15 years old, iron-depleted children of sample size 401, were randomly given to either a daily wheat-based lunch meal fortified with 6 mg of iron or with identical unfortified control feed. The prevalence of ID and ID anaemia in the treatment group remarkably dropped from 62 to 21 per cent and 18 to 9 per cent, respectively (Muthayya *et al.* 2012).

Studies showed that the intake of fortified milk by children not only increased mean serum vitamin D levels but also morbidity rate was decreased (18 per cent

lower occurrence of diarrhoea, 26 per cent lowers episodes of pneumonia and 7 per cent lesser days with high fever) (Khadgawat *et al.* 2013).

Effect of carotene fortified cooking oil from Red Palm Oil (RPO) on blood retinol was assessed by Marliyati *et al.* (2016). Pre and post controlled trial was done on 31 elementary school children of Indonesia aged 7-9 years, into a control group (n= 16) and RPO group (n= 15). Retinol concentration in blood were measured initially and after eight weeks. Results showed that serum retinol level increased by 5.31 µg/dL (50.9%) in the RPO group and 3.25 µg/dL (29.8%) in the control group, but there were no significant difference between the control group and the RPO group after the intervention.

The World Food Programme (2016) conducted a study in the Odisha on 6-14 year old by subsuming iron-fortified rice in the mid-day meals. Each 100g of fortified rice provides 10mg of iron contributing to around 50 per cent of the RDA. Results indicated, 20 per cent decline in the occurrence of anemia, bringing it down from 65 to 45 per cent.

2.3 NUTRIENT CONTRIBUTION

The section shows the percentage contribution of fortified foods to Recommended Dietary Allowances (RDA) of the population.

A study was carried out by Walsh *et al.* (2010) on nutrition contribution of fortified food products in Irish teenagers of age 13 to 17 years and of sample size 441. The main food groups containing fortified foods were ready to eat breakfast cereals, squashes, cereal bars, soups, fruit juices and curd. These foods were daily contributing a major percentage of micronutrients namely: vitamin B6 (21%), vitamin B1 (21%), niacin (14%), folate (25%), vitamin B2 (21%), iron (23%), sodium (8%), vitamin C (6%), vitamin D (13%) and Calcium (7%). Whereas iron, folate vitamins B1, B2, B6, niacin and vitamin D were contributing to about 13-25 per cent in the diet.

Bhawana (2012) conducted research on the development and evaluation of vitamin A and iron-fortified milk. Two iron salts (ferric pyrophosphate soluble (FPP) and ferrous gluconate hydrate (FGH) and vitamin A acetate were selected for the fortification of toned milk. The optimum fortification level in milk was 25 ppm iron

(FPP soluble) and 2500 IU/L vitamin A acetate. Fortified milk of amount 250 ml will contribute to 30-35 percent of Vitamin A and iron requirement daily.

Lailou *et al.* (2012) assess the influence of fortified staples on micronutrient intake on young children of age 6 months to 5 years in Vietnam. For calculating the nutrient intake 24-hour recall method was used. Additionally fortified Vegetable oil containing vitamin A was offering to around 21–24 percent for VRDA (Vietnam Recommended Dietary Allowances), whereas fortified rice supports the intakes of 14 to 61 percent for iron, 4 to 11 per cent for zinc and 33 to 49 per cent of folic acid requirements.

Barr *et al.* (2013) carried out a study to examine associations among breakfast, nutrient intakes and nutrient insufficiency in Canadian adults aged more than 19 years (n=19,913). The consumer were classified as consumer who do not consume breakfast, consumer eating ready-to-eat cereal (RTEC) or other breakfast consumers. A 24-hour recall method was used to calculate nutrient intake. The prevalence of inadequacy for total vitamin C intake was notably higher in breakfast non-consumers when compared with RTEC fortified breakfast consumers. The incidence of insufficient intake of calcium, iron, and vitamin D were similar between breakfast non-consumers and other breakfast consumers, but both groups had a significantly higher insufficiency than the RTEC breakfast consumers. The incidence of thiamin insufficiency was remarkably higher in the other breakfast consumers than in the RTEC consumers, although neither of these groups differed from the breakfast non-consumers.

Berner *et al.* (2014) performed research on micro-nutrient contribution through fortified breakfast cereal on 7,250 consumer of age 2 to 18 years. Data revealed that more than half of the intakes of vitamin D, thiamin and folate, intakes of vitamins A & C, riboflavin, niacin, B6, B12 and iron was 20-47 per cent whereas intake of zinc was offering 12-18 per cent from fortified foods.

Fulgoni and Buckley (2015) carried out research in U. S.A. to assess the nutrient contribution of fortified ready to eat cereal (RTEC) when introduced in the diet of individual of age ranging from 2 to 18 years, 19 to 99 years, and 2 to 99 years. Before the introduction, the percentage of those aged 2 to 18 years that were below Estimated Average Requirements (EARs) increased by 155 per cent, 163 per cent,

113 per cent and 35 per cent for niacin, iron, thiamin, and vitamin A, respectively. Vitamin B6 and zinc, were offering 118 per cent and 60 per cent of EAR respectively.

Pastorelli *et al.* (2015) investigated a study with the objective to find out whether the recommended salt intake of 5g/day in the adult population is sufficient to meet the RDA requirement. The results revealed that daily consumption of 5gm of salt iodised at 30mg/kg was adequate to meet the iodine intake in the adult population.

Vaesken *et al.* (2015) conducted a study on women of childbearing age to assess the potential contribution of foods fortified with folic acid (FA) when included as part of a healthy breakfast. The result showed ten breakfast models accounted for 20-25 per cent of total daily energy recommendations for women. Unfortified breakfast models provided on an average 4-23 per cent of the folate Recommended Nutrient Intake (RNI) whereas 20-50 per cent of RNI was fulfilled with the inclusion of ≥ 70 μg /serving of FA-fortified food. None of the evaluated models exceeded the FA Upper level.

According to the Food Safety and Standards (Fortification of Foods) Regulation (2016) fortified rice and wheat flour, shall contain iron at the level of 20 mg/kg, folic acid at the level of 1300 μg , Vitamin B12 at 10 μg , in addition it may also be fortified with zinc (30 mg), vitamin A (1500 μg RE), thiamin (3.5 mg), riboflavin (4 mg), niacin (42 mg), pyridoxine at (5 mg). Vegetable oil with vitamin A and vitamin D at the levels of 25 IU and 4.5 IU per gram of oil respectively. Edible salt shall be fortified with iodine and may also be fortified with iron, in combination with iodine, at the levels of not less than 15 ppm on the dry weight basis at the retail level and iron at the extent of 850-1100 ppm. Milk with vitamin A (770 IU) and vitamin D (550 IU), either singly or in combination.

A study was performed to know the vitamin D fortified foods contribution to the diet of Danish women aged 18-50 years (n=855). Four fortified products namely, plain yogurt, cheese, eggs, and crisp-bread contributed a total daily dose of 20 μg /day and a vitamin D in their diet, which is the 20 per cent of recommended dietary allowance (Gronborg *et al.* 2018).

Using a 24-hour recall, the contribution of micronutrients of fortified maize meal and bread was assessed on infants of age: 6, 12, and 18 months in South Africa was determined by Swanepoel *et al.* (2018). The intake of fortified staples was

offering ~20 per cent for zinc and niacin, ~25 per cent for iron and thiamine and ~33 per cent for vitamin B6 and folate. Children of 6 months of age were consuming ~33 per cent for iron and zinc and more than 50 per cent for thiamine, vitamin B6, and folate through the fortified meal. Iron and zinc were contributing more than 40 per cent whereas, thiamine and vitamin B6 were offering more than 50 per cent in the diets of 12 months old children, and more 70 per cent for folate was contributed though diet in 18 months old children. However, despite fortification, nutrient gaps persists.

2.3 STUDIES ON CONSUMER KNOWLEDGE, PERCEPTION AND PRACTICES TOWARDS FORTIFIED FOODS

2.3.1 CONSUMER KNOWLEDGE

A total of 58 participation were selected to assess knowledge of micronutrient deficiencies and fortified foods in Armenia. The results showed that the majority of participants, had no concept of food fortification. Most of the primary health care providers had limited knowledge about the topic. Millers were more knowledgeable, specifically more about fortified flour. Almost all participants knew about iodized salt which is necessary to prevent goiter (Truzyan *et al.* 2009).

Pounis *et al.* (2011) carried out a study on the use of iron-fortified foods related with their knowledge & understanding of nutritional aspect. One point increase of overall nutrition knowledge score and one point increase in iron nutrition knowledge score was associated with a 4.3 per cent 20 per cent higher likelihood that the consumer believes that iron-fortified foods have a positive role in the diet and consumption of iron-fortified foods more often. Results showed consumer perception of iron-fortified foods seems to be associated with nutrition knowledge.

Nagaraj *et al.* (2013) performed a research to assess the knowledge level regarding targeted fortified products of 300 rural and urban mothers from Rajasthan. The data was collected using a self-administered questionnaire. A total of 53.33 per cent rural and 65.33 per cent urban mothers had knowledge ($P=0.046$), amongst which 52.67 per cent rural and 66 percent urban mothers ($P= 0.026$) consumed targeted fortified products (TFP). There was notably less awareness among rural pregnant women when compared to the urban population.

Otieno (2013) conducted a study on 350 consumers in urban and rural setup in Kenya, with the objectives to assess the consumers' awareness and their preferences towards fortified sugar. The results showed that about 55 per cent of the consumers were aware of fortified sugar and that awareness levels were statistically higher for urban consumers. Consumer' age, buying behaviour, reading newspaper, and urban area were the notable factors affecting consumers' awareness towards fortified sugar.

To assess the awareness, and consumption of fortified foods in Mumbai, Battalwar (2016) using a structured questionnaire performed a research on 100 females between the age group of 18 to 60 years. Results showed that 43 per cent, 76 per cent and 28 per cent were aware of the term food fortification, consumed fortified foods, and considered them healthy respectively, other 28 per cent gave a mixed response. About 64 consumer and 42 consumer responded that they are affordable and aware about it by reading on the pack of the container or through TV/magazines/newspaper/internet. The overall awareness was poor.

Motadi *et al.* (2016) investigated a study on 120 women of child bearing age of South Africa with the aim to determine the knowledge regarding food fortification. The results revealed that most of the consumer (57%) were able to define the term food fortification. Whereas 72 per cent consumer knew which foods are fortified and their benefits.

A total of 120 caregivers with 6 to 23 month-old children were randomly chosen, to study their knowledge and practice of use of multiple micronutrient powders (MMP) in Philippines. 10 to 40 per cent of consumer accepted of having insufficient awareness about MNP's use, whereas 20 per cent of consumer declared to observe certain changes in their children due to the consumption of powder. The results further revealed that there was an increased appetite and growth and development of children. Overall there was a lack of knowledge about the MNP even if all consumer claimed to be aware about it (Gordoncillo *et al.* 2017).

Kasankala *et al.* (2018) reported a study on Knowledge and Awareness on Food Fortification among 200 Mother/Child Caretakers in Tanzania. The findings of the study showed that 29 per cent and 79 per cent of participants heard the term food fortification but don't know the types of foods being fortified with micronutrients. The main source of information was through health workers (41.7%) and posters

(0.1%) was the rarely used aid for awareness. The study further noted more than 50 per cent of the consumer were not aware of the health benefits of the micronutrients being added in food. The findings further revealed that knowledge and awareness of food fortification were not affected by income, education qualification and age of the Mother/Child Caretakers.

Bromage *et al.* (2019) assessed the awareness regarding industrial food fortification among men and women of age 18 years or more in urban and rural Mongolia. Results showed that only 19 per cent of rural and 30 per cent of urban Mongolians were aware of the industrial fortification practiced in their countries. A total of 55 per cent of rural and urban Mongolians preferred compulsory fortification of foods, 14 per cent disapproved and 31 per cent were not sure. Overall awareness and understanding of food fortification was low.

2.3.2 CONSUMER PERCEPTION

Fortified foods are quite similar to functional foods, as they share specific characteristics like health benefits and helps in treating various micronutrients deficiencies. However, there is little information or data available in the journals on consumer perception and demand for fortified foods. Perception is defined as the arrangement, recognition, and elucidation of sensory information in order to understand the surroundings (Daniel, 2011).

Perception can be divided into two processes. Firstly there is the conversion of low-level information to high-level information. Secondly, organising person's concepts and expectations (knowledge) and attention that affects the perception (Douglas, 2010). Consumer perception is the way that customers usually view, believe or feel about certain objects and utilities.

A research was performed to know the consumer perception of nutrition and health decelerations of food products containing additional or reduced levels of a particular ingredients in Germany, Italy, United Kingdom, and United States of America. Nutritional health declaration reported by consumer that these items were better than regular, healthy, reduces the risk of diseases, tastes better and marketing strategy to increase the sale. The overall findings revealed that consumer perception differs remarkably by the nation (Van and Van, 2007).

Truzyan *et al.* (2009) assessed the perception of food fortification in preventing anaemia in Armenia on total of 58 participants. The results revealed that some consumers showed distrust towards flour fortification and believed that iron fortification is unsuccessful in preventing anaemia. Some perceived that fortification leads to accumulation and toxicity of iron and causes obesity, whereas some perceived it taste different.

In the article published by William Davidson Institute at the University of Michigan (2013) on about Debunking the Myths behind Food Fortification. Food fortification has no relation with genetic modification or breeding of plants nor does it promote the consumption of certain foods over others. The fact that it is cost effective makes it easy to improve nutrient intake relatively quickly and at large scale.

Latha (2014) conducted a study on consumer knowledge and perception of 200 household consumers of Hyderabad. The results showed that all the participants (100%) were aware of the fortified foods. 81 per cent participants strongly agreed that fortified foods have added micronutrients. Whereas 56 per cent moderately agreed that fortified foods are natural. About 61 percent disagree that these are the complete or balanced meal. Though most of the consumers strongly agreed that it is a foreign concept (52%) but 60.5 per cent does not agreed that it is a fancy food or food for rich people (56%). Fortified foods are meant for sick people is also disagreed by the majority of the selected consumer (71%).

To assess the community perception regarding micronutrient fortified complementary food (balbhog) Nakkeeran *et al.* (2015) investigated a study on mother feeding balbhog to their 6-36 months old children in the state of Gujarat. In the findings, it was found out that most of the mothers were aware of the fortified food product and able to differentiate it with other fortified items. There was positive perception towards the product, that it is nutritious, prevent diseases, good for children as it has iron fortified, it tastes good, easy to prepare and saves time whereas the non-users had a negative perception they stated that it has undesirable smell and taste, it has added medicine, sometimes child facing diarrhoea, does not believe in added micronutrient claims.

Romotsky (2017) carried out research on the perception of Americans towards fortified foods. Findings showed that 54 per cent perceived fortification has no effect on taste. More than half (53%) of consumers preferred eating fortified rather than non-fortified foods. About 51 per cent agreed that they have health-promoting ingredients. Around 33 per cent consumers strongly agreed with the idea that their children getting health-promoting ingredients from fortified foods.

Verrill *et al.* (2017) performed research on US adults aged 18 years and older (n=5,076) to assess whether vitamin-fortified snacks affect consumer's information-seeking, buying decisions, and an item related health perceptions. Participants were selected randomly to one of 24 situations: namely, two types of chips made from vegetables or either potato chips, two nutrition profiles healthier and less healthy, non-fortified and fortified, and three nutrient claims that were not printed on product packaging, two with no health declaration and one with the health claim. Results revealed that when the food carried a nutrient claim that it contains added vitamins, participants were less likely to look at the nutrition panel and are more likely to select the product for buying and perceive the item as healthier, and less likely to correctly choose the healthier product.

2.3.3 CONSUMER PRACTICES

Mabaya *et al.* (2010) studied the preferences and readiness to pay for fortified cereal foods in Botswana and the results showed that the brand, quality, price, colour/appearance, and nutritional value were the most important factors. There was a close correlation between areas they are living and the knowledge about fortified foods. Rural people had the least knowledge. There was very limited knowledge about food fortification and its benefits due to which the readiness to pay for fortified milled products was very low among consumer.

Food and Nutrition Research Institute (2014) conducted a study on awareness and use of fortified foods in the Philippines and revealed that awareness of the Sangkap Pinoy Seal (SPS) was 16.7 per cent whereas; knowledge of fortified foods, was only 11.6 per cent. Almost all households use SPS and other fortified foods.

Kaur and Singh (2014) studied consumer behavior in the purchase of processed cereal food products in three cities of Punjab with a sample size of 300 consumer. The

research revealed that external impact, healthiness, and brand responsiveness and quality were the major factors that influence people to eat processed cereal food.

A study was done on the consumption of fortified foods on 200 consumer in Hyderabad city. It was revealed that the most popular brand in fortified breakfast cereal (cornflakes) was Kellogg (76.5%). In the case of wheat flour, Aashirvaad brand was the most preferred (42.5%). In the category of juices Tropicana, fruit juice brand was preferred by the majority of consumer (52.5%). Horlicks was the first choice in fortified beverages. In the oils category, the Fortune, Saffola, and Sundrop are preferred by a nearly an equal percentage of consumer (Latha, 2014).

Battalwar and Syed (2015) conducted a study on consumer practices regarding fortified foods among 100 females between the age group of 18 to 60 years in Mumbai city. Unawareness, cost, not advantageous, and not easily available were the reasons of not purchasing them (25%), while 30.10 per cent said, it's healthy as well as increases power and build up the immunity.

The objective of the study was to assess the knowledge and perceptions of mothers and fathers, regarding the logo developed for Vietnam's National Fortification Program. Survey findings identified that one of the current major obstacles for consumers purchasing fortified foods was the low awareness of the logo and resultant low motivation by consumers to purchase fortified foods over cheap, non-fortified products (Turk *et al.* 2016).

Quang *et al.* (2016) stated that the graphic design of a logo can intensify customer interaction with fortified products. These included endorsement for an easy, colorful layout and which quickly grab the attention of the consumer. A change in language could also be considered to the better-understood terms of vitamins and minerals instead of using the term micronutrients.

Deshmukh and Goyal (2017) investigated a study on food label reading practices on 838 consumers of Indore city. From the results, it was revealed that more than half of the participants (54.9%) check vegetarian and non-vegetarian sign followed by 40 per cent notice manufacturing and expiry date on food labels before purchasing. It was also revealed that 52.7 per cent customers do not check the purity markers. Whereas, 52.5 per cent consumers do not read the ingredients on food products, while 63.2 per cent consumers do not see the net quantity of the product.

As per the FSSAI (2018) regulation, every fortified staple should contain a +F logo which fulfills the Food Safety and Standards (Fortification of Foods) Regulations. The plus sign indicates adding micronutrients. And the ring around the letter F illustrates good health and protection. The Colour Blue symbolizes purity and good health. This logo will help consumers identify the fortified food commodities in an easy, straightforward manner.

Thus, from the findings it can be concluded that the prevalence of hidden hunger or malnutrition is common phenomenon in urban population too. Majority of them were suffering from multi-micronutrient deficiencies. Studies on efficacy of fortified foods or trials on different population groups namely children, adolescent girls, men and women proved that consumption of fortified foods is an effective strategy to fight with this alarming situation. Food fortification is very cost-effective, scientifically proven and feasible approach to treat malnutrition, still people had no knowledge regarding this topic. Very few percentage of people were aware about this term and most of them had very negative perception towards it. Thus these reviews will help in supporting the results of current study.

METHODOLOGY

This section deals with the approach that was followed to accomplish the objectives of the present study entitled “Assessment of Consumer Knowledge, Perception, Practices towards Fortified Foods and their Nutrient Contribution.”

This chapter deals with the detailed description of methods and procedures along with their relevant details under the following sub-headings:

3.1 Locale of the study

3.2 Sample and its selection

3.3 Research tool and its description

3.4 Procedure of data collection

3.5 Development of folder

3.6 Data analysis

3.1. LOCALE OF THE STUDY

The present study was conducted within the municipal limits of Udaipur city of Rajasthan.

3.2. SAMPLE AND ITS SELECTION

Sample: In Indian society, most of the women handle the bulk of the grocery shopping for the family and are most often the exclusive preparer of the meals. At the age of 25 and above an individual starts to earn and is mature enough to make their own choices on purchasing different food products. Therefore a sample of total of 150 female consumers of age 25 and above years was selected.

Sample selection: Sample frame in which a list of supermarkets located in different parts of Udaipur city was prepared by collecting information from various primary and secondary sources. In primary source, information was collected by personally contacting the supermarket retailers through snowball technique whereas secondary sources were internet, newspapers and local magazines. From the prepared list 5, supermarkets were randomly selected from which 30 consumers each were chosen by convenience sampling. (Appendix V)

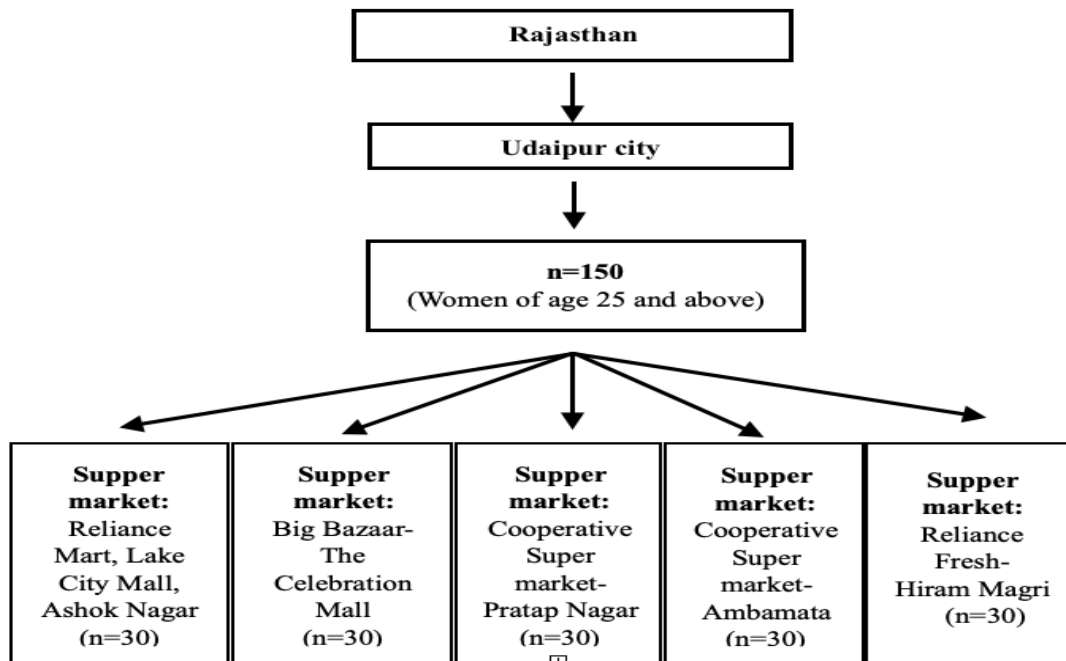


Figure 3.1 : Selection of Consumer

3.3 RESEARCH TOOL AND ITS DESCRIPTION

Development of the tool to achieve the objectives of the research is an important step in any research. Keeping in mind the purpose of the study, the researcher developed a questionnaire to study the knowledge, perception and practices regarding fortified foods among female consumers. The questionnaire was distributed among 20 non-sample consumers to check the clarity and understanding. The necessary modifications were made on the basis pretesting and after final corrections and modification the following sections were included in the questionnaire:

- i. Background information
- ii. Knowledge assessment
- iii. Perception of fortified foods
- iv. Practices of fortified foods

i. Background information

Background information proforma was prepared to obtain basic details about the consumers. The information included their name, age, religion, caste, education qualification, occupation, marital status, type of family, family income, food habits, health-related issues, intake of food supplements or not.

a) **Age:** The chronological age of the consumer at the time of data collection was recorded. The consumer were categorised into 3 groups on the basis of their ages as depicted in table 3.1.

Table 3.1 Categorisation of the consumer based on the age

S. No.	Categories (years)
1	25-36
2	37- 48
3	49-60

b) **Religion:** On the basis of religion, consumer were categories into 3 heads

Table 3.2 Categorisation of the consumer based on the religion

S. No.	Categories
1	Hindu
2	Muslim
3	Christian

b) **Caste:** On the basis of caste, consumer were categories into 4 groups as follows:

Table 3.3 Categorisation of the consumer based on the caste

S. No.	Categories
1	General
2	SC
3	ST
4	OBC

c) **Education qualification:** On the basis of education qualification, consumer were categories into 4 heads as below:

Table 3.4 Categorisation of the consumer based on the education qualification

S. No.	Categories
1	Secondary
2	Senior secondary
3	Graduate
4	Post graduate

d) **Occupation:** On the basis of occupation, consumer were categories into 5 categories mentioned below.

Table 3.5 Categorisation of the consumer based on the occupation

S. No.	Categories
1	Student
2	Government sector
3	Private sector
4	Unemployed
5	Housewife

e) **Marital Status:** On the basis of marital status, consumer were categories into 2 groups as follows:

Table 3.6 Categorisation of the consumer based on the marital status

S. No.	Categories
1	Married
2	Unmarried

f) **Family type:** Depending on the the composition of the family, consumer were categorised into following heads:

Table 3.7 Categorisation of the consumer on the basis of family type

S. No.	Categories
1	Nuclear
2	Joint

g) **Family monthly income:** Family income means the income earned by all the members of the family in a month. Income can be from employment, business, rent, pension, etc. on the basis of these aspect, income was grouped into the following sections by using equidistant formula.

Table 3.8 Categorisation of the consumer on the basis of family monthly income

S. No.	Categories (Rs.)
1	20000-46000
2	47000-73000
3	74000-100000

h) Consumer were divided into 3 groups based on the food habits.

Table 3.9 Categorisation of the consumer on the basis of their food habits

S. No.	Categories
1	Vegetarian
2	Non- Vegetarian
3	Ova- vegetarian

v) **Health problems:** Consumer were categorised into following major health related issues if any.

Table 3.10 Categorisation of the consumer on the basis of the health problems

S. No.	Categories
1	Diabetes
2	Hypertension
3	Obesity
4	Hypothyroidism
5	No health problem

j) Furthermore, consumer were also asked whether they consume any food supplements, namely multivitamins and minerals.

ii. Knowledge assessment

Bloom *et al.* (1956) stated knowledge as those behaviour and test situations, which draw attention by remembering either by remembrance or recollection of ideas, materials and phenomenon. Knowledge is the acquisition or understanding of facts, data, and information, skills, which is acquired by the person through education or by doing or learning, or through experience.

Knowledge can be tested by presenting questions on a particular topic with a score assigned to them to check the level of knowledge among people. A questionnaire was developed to assess the consumer knowledge fortified foods. Questions regarding the concept, advantages, health benefits and logo, various fortificants, micronutrients deficiencies, the role of micronutrients were included in this section.

Comparison of knowledge level between different age groups and education qualification was done using ANOVA (analysis of variance). The 3 categories of age viz., 25-26 years, 37-48 years and 49-60years were assigned groups I, group II and

group III respectively and 4 categories of education qualification namely, secondary, senior secondary, graduate and postgraduate were selected for the analysis.

Scoring pattern

This section consists of 20 questions. Each correct response was assigned a score one each and incorrect as zero. Marks were ranges from 1 to 12 as per questions (Distribution is given in the Table: 3.11). The higher was the score, the better was the knowledge. The maximum score was 46. Using equidistant formula, total score (46) was divided into 3 knowledge levels; poor, average and good. An individual with a score within the range of 32-46 was considered to have a good level of knowledge, scores ranging from 16-31 represented average knowledge and scores from 0-15 denoted poor level of knowledge. The details regarding the interpretation of scores to find the level education are given in the table.

Table: 3.11 Distribution of scores to assess knowledge

Score assigned	Question numbers
Score 1	1, 3, 4, 5, 6, 7, 8, 10, 12, 13, 14, 15, 18,
Score 4	2, 9, 11, 16, 17, 19
Score 12	9

Table. 3.12 Interpretation of scores to assess knowledge level

Scores	Interpretation
0-15	Poor
16-31	Average
32-46	Good

iii. Perception towards fortified food

According to the Cambridge dictionary, perception is a belief or point of view of many people and based on how objects seem. Consumer Perception is defined as the way that customers usually view or feel about certain services and products. A total of 25 Statements were prepared to assess the perception of consumers toward fortified foods. The consumers were given the choice to either strongly agree or agree or neutral or disagree or strongly agree with the statements.

They were divided into four sections namely nutrition and health, safety and risks, consumption and comparison with other foods. Statements were both negative and

positive i.e., fortified products are a complete food, fortified foods are synthetic, fortified foods helps to cure micronutrient deficiencies, etc.

Table: 3.13 Sections of Perception Statements

S. No.	Sections	Total items	Item wise S. No.
1	Nutrition and health	8	1-8
2	Safety and risks	6	9-14
3	Consumption	4	15-18
4	Comparison with other foods	7	19-25

iv. Practices of fortified food

Questionnaire was developed to find out the existing practices of consumers regarding the consumption of fortified foods. Information was gathered regarding the consumption, reasons for purchasing, label reading practices, preferred brands, etc.

Fortified food frequency

A fortified food product list of various food products like milk, oil, wheat flour, breakfast cereals, health drinks was prepared from which consumers were asked about the amount they consume and how frequently they are consuming them (daily/once in a week/ twice in a week/ fortnightly/never). One day recall of micronutrients was calculated from the quantity consumed which were then compared with the RDA (Recommended Dietary Allowance) to calculate the nutrients contribution in the diet.

Micronutrient intake: Micronutrient intake was calculated using the mentioned nutritional information from the package of the fortified food product. The consumers were asked to fill the amount they consume. Intake for one day was compared with the Recommended Dietary Allowances (NIN-2010) of moderate working women and percent adequacy was calculated as follows:

$$\text{Percent adequacy of nutrient intake} = \frac{\text{Micronutrient intake}}{\text{Recommended dietary allowance (RDA)}} \times 100$$

Pilot study:

Pilot testing of the tool was done on 20 female consumers belonging to the age range of 25 and above years by considering the delimitations of the research to conform the

suitability of the tool. The sample of pilot study was not included in the original sample for the study (n= 150).

3.4 Procedure of data collection

Questionnaire technique was used to gather data from the consumers. This technique was considered more appropriate since a large number of people can be reach relatively easily and economically. It is less time consuming and consumer feel anonymous to answer questions without any hesitation. Questionnaires were distributed by personally contacting female consumer from 5 supermarkets by convenience sampling.

3.5 Development of information material

A folder on the importance of fortified foods was developed in order to fulfil the fourth objective of the present research. The folder was prepared in English language since consumers were hard to understand the subject matter in Hindi language. Relevant information was gathered from various authentic online sources, literatures, magazines, books for the content of the folder. The developed folder was subjected for the evaluation by a panel of 10 experts from Food Science and Nutrition, Resource Management and Consumer Sciences and Extension Education and Communication Management. All the experts were contacted personally with an evaluation sheet to assess the designed folder. The expertise were requested to judge the folder on various criteria which are as follows:

1. Content
2. Accuracy
3. Language clarity
4. Suitability to the consumer
5. Layout and Design
6. Overall presentation

The folder was evaluated on the basis of these criteria on a five-point continuum i. e., excellent, very good, good, fair and poor with score 5, 4, 3, 2, and 1, respectively. On

the basis of scores assigned by experts, mean score for each criterion was calculated. Further folder was modified based on the suggestions of the expertise.

3.6 Analysis of data

To analyse the data, the collected information is scored, coded, categorised and put under statistical measures according to the requirements of the objectives of the study. Below mentioned statistical methods were used in the analysis and interpretation of the data.

- i. Frequency, percentage, mean, standard deviation and mean percent score were used to analyse the general background information, knowledge, perception and practices of the consumer.
- ii. Analysis of variance (ANOVA) one way classification was used to compare knowledge among different age groups and education qualification of the consumers. Formulas used in the analysis are mentioned below:

i. Mean:

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

Where, i = observation

n = number of observation

X= observed value of sample

iii. Standard deviation

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^n (X - \bar{X})^2}$$

Where, i = observation

n = number of observation

\bar{X} = mean value of observation

X= observed value of sample

iii. Mean Percent Score (MPS):

$$\text{MPS} = \frac{\text{Meanscore}}{\text{Maximumscore}} \times 100$$

iv. Analysis of variance (ANOVA) one way classification:

Table 3.14 ANOVA for one way classified data

Source of Variation	Degree of Freedom (DF)	Sum of Squares (SS)	Mean of Sum of Square (MS)	F _{calculated} value
Treatment	t-1	SST	$MST = \frac{SST}{(t-1)}$	$F_{(t-1, n-t)} = \frac{MST}{MSE}$
Error	n-t	SSE	$MSE = \frac{SSE}{(n-1)}$	
Total	n-1	TSS		

Where, $n = r \times t$

r= number of replication

t= number of treatments

MST = mean sum of square due to treatment

MSE = mean sum of square due to error

Sum of Squares due to treatment (SST):

$$SST = \frac{\sum_{i=1}^t \left[\sum_{j=1}^r X_{ij} \right]^2}{r} - \frac{\sum_{i=1}^t \left[\sum_{j=1}^r X_{ij} \right]^2}{rt}$$

Where, X_{ij} = value of j^{th} observation receiving i^{th} treatment

$i = 1, 2, 3, \dots, t$

$j = 1, 2, 3, \dots, r$

Total sum of squares (TSS):

$$TSS = \frac{\sum_{i=1}^t \sum_{j=1}^r X_{ij}^2 - \sum_{i=1}^t \left[\sum_{j=1}^r X_{ij} \right]^2}{rt}$$

Sum of squares due to error (SSE):

$$SSE = TSS - SST$$

Standard error of difference between two treatments means (SEd):

$$SEd = \sqrt{\frac{2MSE}{r}}$$

Critical Difference (CD_α):

The critical difference was calculated for finding out the significant difference between the corresponding two treatment mean values.

CD_α = SEd × tabulated t_α for error degree of freedom

Where, α = level of significance

Error degree of freedom = n-t (from table 3.3)

RESULTS AND DISCUSSION

It is crucial for the success of any research that the data gathered in interpreted empirically and verifiably. For the comprehensive interpretation of the results obtained during the research period, the data is analysed, tabulated and presented systematically using relevant supportive material. The findings of the present investigation has been discussed under the following heads:

4.1. Background information of the consumers.

4.2. Knowledge towards fortified foods.

4.3. Perception of consumer towards fortified foods.

4.4. Existing practices of consumers regarding the consumption of fortified foods.

4.5. Contribution of nutrients through fortified foods.

4.1 BACKGROUND INFORMATION OF THE CONSUMERS

Background information of consumers play a very noticeable role in understanding their responses and to make the analysis more relevant. Thus this section deals with the background characteristics like age, caste, religion, education, occupation, marital status, monthly income, family type, food habits, health-related issues and use food supplements.

1. Age

Majority of consumer (68.67%) were in the category of 25-36 years, followed by 15.33 per cent falls in the age range of 37-48 years. Whereas 16 per cent belonged in 49-60 age range.

2. Religion

Most of the consumers (78%) were Hindu, 16.7 per cent belonged to Muslim religion followed by 5.3 per cent were Christians.

3. Caste

Caste referred to the class or district heredity order of society. Majority of consumers (78%) belonged to the general category, followed by 8.3 per cent were of scheduled caste, 6 per cent belonged to scheduled tribe and 7.3 per cent were of other backward class.

4. Education qualification

Education qualification is a prime measure that might affect an individual's attitude and belief towards a particular situation. The response of an individual is most likely to be influenced by her education attainment level. Among the selected consumer most of them were postgraduates (58%) followed by 30.7 per cent were graduates, 7.3 per cent were secondary passed and 4 per cent had the education qualification upto senior secondary.

5. Occupation

Table 4.1 elaborates the occupation details of the consumers. Nearly 19 per cent consumers were students, around 13 per cent were in government sector, and 28.7 per cent were from the private sector, whereas 5.3 per cent and 33.3 per cent of consumers were homemakers and unemployed respectively.

6. Marital status

Data regarding marital status show that the majority of them were married (68.7%), whereas 31.3 per cent were unmarried.

7. Family type

On the basis of size, structure and number of generation, families can be classified into nuclear and joint families. Consumers belonging to nuclear families were 52 per cent whereas 48 per cent consumers were from joint families.

8. Family income (monthly)

Family income is the income earned by all members of a family. In the present study, most of the participants (44.67%) monthly family income was in the range of 20000-40000 Rs. followed by 37.33 per cent were in the category of 47000-73000 Rs. and only 18 per cent were belonged in the range of 74000-100000 Rs.

9. Food habits

Food habits are classified into in three heads vegetarian, non-vegetarian and ova vegetarian. From the findings it could be stated that 55.3 per cent consumers were vegetarian, 34.7 per cent were non vegetarian and only 10 per cent were ova vegetarian.

10. Health issues

It is evident from Table 4.1 that 11.33 per cent consumers were hypertensive, 9.3 per cent obese followed by diabetic (6%) and hypothyroidism (4.7%). No health issues were reported by 68.7 per cent of consumer.

11. Use of dietary supplements

Findings reveals that 20 per cent consumer were consuming dietary supplements namely, multivitamins and minerals, protein powders, iron, calcium and Vitamin D supplements. Some studies stated that food supplements use is more common among

women, the elderly, and those with higher education qualification (Bailey *et al.*2011). Multivitamin and mineral supplement are the most commonly consumed supplement (Murphy *et al.* 2011).

Table 4.1 Distribution of the consumers on the basis of background information

n= 150

S.No.		Background variables	f	%
1	Age	25-36	103	68.67
		37-48	23	15.33
		49-60	24	16
2	Religion	Hindu	117	78
		Muslim	25	16.7
		Christian	8	5.3
3	Caste	General	117	78
		Scheduled Tribe	9	6
		Scheduled Caste	13	8.7
		Other Backward Class	11	7.3
4	Education qualification	Secondary	11	7.3
		Senior secondary	6	4
		Graduate	46	30.7
		Post graduate	87	58
5	Occupation	Student	29	19.3
		Government employee	20	13.3
		Private job	43	28.7
		Housewife	8	5.3
		Unemployed	50	33.4
6	Marital status	Unmarried	47	31.3
		Married	103	68.7
7	Family type	Joint	72	48
		Nuclear	78	52
8	Family income (Monthly) in Rupees	20000-46000	67	44.67
		47000-73000	56	37.33
		74000-100000	27	18
9	Food habits	Vegetarian	83	55.3
		Non-vegetarian	52	34.7
		Ova- vegetarian	15	10
10	Health related issues	Diabetes	9	6
		Obesity	14	9.3
		Hypertension	17	11.3

		Hypothyroidism	7	4.7
		No health issues	103	68.7
11	Intake of dietary supplements		30	20

4.2 CONSUMERS KNOWLEDGE TOWARDS FORTIFIED FOODS

In this study the knowledge refers to the amount of information possessed by the female consumers, with regard to the fortified food products. The first objective of the study was to assess the existing level of knowledge about fortified food products of female consumers. Knowledge was categorised into poor, average and good based on the total score of knowledge test (total score was 46).

Table 4.2 Distribution of consumers on the basis of knowledge level

n= 150

S. No.	Knowledge Level	<i>f</i>	%
1	Poor (0-15)	78	52
2	Average (16-31)	54	36
3	Good (32-46)	18	12
	MPS		41.49

MPS- Mean Percent Score

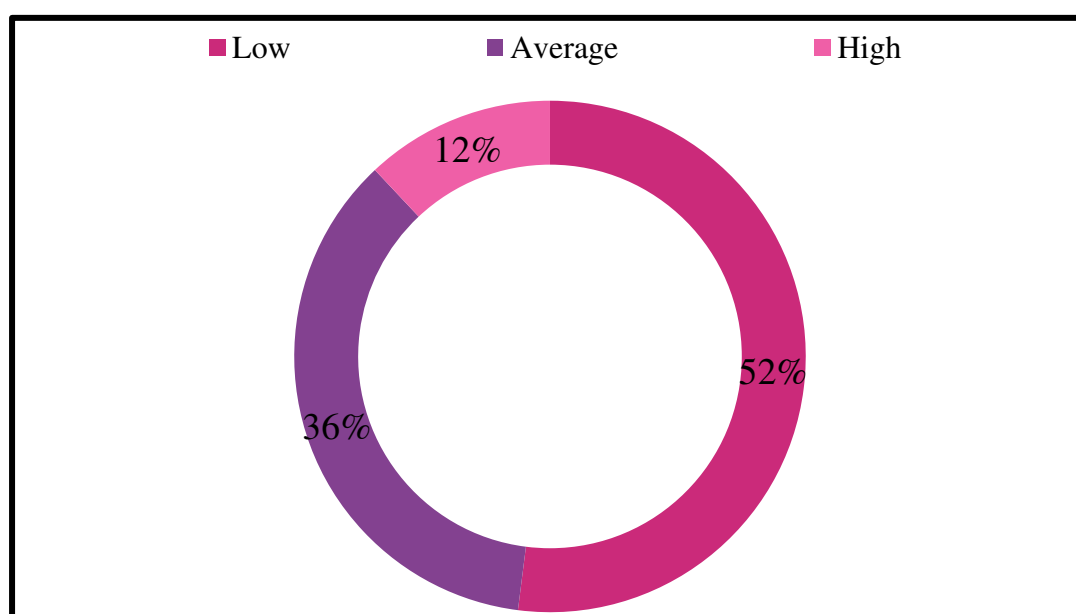


Figure 4.1 Distribution of consumers by knowledge level

Table 4.2 and Figure 4.1 gives a consolidated picture of knowledge. Majority of the consumers had poor knowledge (52%) regarding fortified food products. Whereas 36 per cent of the consumers had average knowledge. Only 12 per cent have shown good knowledge about fortified foods. The overall mean per cent score was 41.49.

The similar results were shown by Battalwar and Syed (2015) who reported that the overall awareness towards fortified foods was poor. Truzyan *et al.* (2009) stated that most of the subject had no idea of food fortification. Majority of health-care professional had poor knowledge about the subject. Bromage *et al.* (2019) said that very few urban Mongolians and Harbin were aware that industrial fortification is practiced in their countries.

Table 4.3 Knowledge of the consumers regarding fortified foods

n= 150

S. No.	Knowledge about fortified foods	<i>f</i>	%
1	Aware about the term Food Fortification	77	51.33
2	Food Fortification logo	23	15.33
3	Advantages of fortified foods	77	51.33
i	Improves nutritional status.	60	77.92
ii	Prevent diseases	53	68.83
iii	No change in existing food pattern.	40	51.94
iv	Cost effective	9	11.68
4	Consumption of fortified food decreases the demand of fruits and vegetables.		
i.	Yes	18	12
ii.	No	96	64
iii.	Don't know	36	24
5	Term fortified foods and organic foods cannot be interchangeably used.	96	64
6	Malnutrition can be prevented by fortified foods.	97	64.66

7	Fortification has no effect on shelf life of foods.	25	16.66
---	---	----	-------

Table 4.3 gives a very clear picture that 51.33 per cent of consumers were aware of the term food fortification. Very few consumer were familiar with the fortified logo (15.33%), the reason could be the new launch of the logo (2016) by FSSAI or poor label reading practices by the consumers. The similar findings of Battalwar and Syed (2015) revealed that participants responded that food fortification is the addition or enrichment of food product, whereas the majority of them reported that lack of time while shopping as the major reason for not reading the food labels. Very few stated that the advantages of consuming fortified foods are that it's healthy as well as increases the strength and improves immunity.

Turk *et al.* (2016) reported that the major obstacles for consumers purchasing fortified foods was the low awareness of the logo and resultant low motivation by consumers to purchase fortified foods over cheap, non-fortified products.

Large-scale food fortification is widely recognized as a cost-effective strategy to improve the micronutrient status of the population and very few consumers believed that it is cost effective. (Hoddinott *et al.* 2013). Kasankala *et al.* (2018) stated that very less number of mother/child caretaker were aware of the term food fortification and don't know the types of foods being fortified with vitamins and minerals.

The Table 4.3 further reveal that more than 50 per cent of consumers were not aware of the health benefits of the micronutrients being added in food. Term fortified foods and organic foods cannot be interchangeably used was accepted by 64 per cent of consumers. As organic foods are those foods that are grown without the use of chemical pesticides and are not genetically modified whereas fortified foods are totally different as they are those products in which vitamins and minerals are added in minute quantity.

About 64 per cent consumers were not in the favour that consumption of fortified food decreases the demand for fruits and vegetables, whereas 20 per cent agreed on it. Food fortification is a complementary strategy, not an alternative or the replacement of a balanced diet. Substituting fortified foods with the fruits and vegetable is not a healthy choice since these products fulfil only 30-50 per cent daily requirement of micronutrients. About 64.66 per cent participants agreed that malnutrition can be prevented by fortified foods. These products help to build up stores of vitamins and

minerals in the body thus helps to combat malnutrition. Some of consumers (16.66%) responded correctly that adding micronutrients in foods has no effect on the shelf life of products, but each micronutrient has its own shelf life which with time decreases.

Table 4.4 Consumer knowledge regarding various fortificants**n=150**

S.No.	Fortified products	Micronutrients	<i>f</i>	%
1	Salt	Iodine	143	95.33
		Iron	0	0
		Both	7	4.67
2	Oil	Vitamin A	20	13.33
		Vitamin D	4	2.67
		Both	36	24
3	Milk	Vitamin A	5	3.33
		Vitamin D	3	2
		Both	26	17.33
4	Wheat flour	Iron	7	4.67
		Folic acid	0	0
		Vitamin B12	0	0
		All	8	5.33
5	Rice	Iron	6	4
		Folic acid	1	0.67
		Vitamin B12	0	0
		All	3	2

Table 4.4 reveal that majority of consumers (95.33%) had knowledge that iodine is fortified in salt whereas, very few (4.67%) were aware of the double fortified salt. Fortification of wheat with iron, folic acid and vitamin B12 was also known by fewer consumer (5.33%). Knowledge regarding fortification of rice with iron, folic acid and Vitamin B12 was very poor (2%). Awareness towards the addition of oil with vitamin A and vitamin D was satisfactory (24%), whereas milk is fortified with vitamin A and vitamin D was known by 17.33 per cent of the consumers.

The results are in conformity with the results of Battalwar and Syed (2015). They reported that 52 per cent of the participants knew that salt is added with iodine while

few gave a mixed response with iodine and iron. About 33 per cent were unsure or gave a mixed response about micronutrient fortification. Double fortified salt (DFS) is an effective method in improving the status of iron in the body (Haas *et al.* 2014).

Table 4.5 Knowledge of consumers towards micronutrients

n=150

S. No.	Micronutrient knowledge	<i>f</i>	%
1	Aware about vitamins and minerals	150	100
2	Requirement of micronutrient vary between individuals.	131	87.33
3	Role of micronutrient in diet		
i.	Helps to fight diseases	116	77.33
ii.	Provide energy	116	77.33
iii.	Promote growth and development	101	67.33
iv.	Maintain normal functioning of body	87	58
4	Sunlight is the best source of Vitamin D	145	96.66
5	Calcium and Vitamin D for teeth and bone development	114	76
6	Health benefits of vitamin A		
i.	Prevent blindness	117	78
ii.	Improves immunity against diarrhoea	9	6
iii.	Prevents respiratory tract infections	11	7.3
iv.	Reduces the risks of certain cancers.	30	20
v.	Don't know	19	12.66
7	Health benefits of Antioxidants		
i.	Slows down ageing	103	68.66
ii.	Increases immunity	62	41.33
iii.	Reduces the risk of cataract	37	24.66
iv.	Reduces the risk of stomach diseases	26	17.33
v.	Don't know	44	29.33

The findings of the Table 4.5 depicts that all the consumers had knowledge of various vitamins and minerals. The requirement of micronutrients vary between individuals was agreed by 87.33 per cent of consumer. Consumers were knowledgeable about the role of micronutrient in the diet. About 73.33 per cent believed that they provide

energy and helps to fight diseases. They were also familiar with the role of micronutrients in promoting growth and development (67.33%) and to maintain the normal functioning of the body (58%). Majority of them were aware that sunlight is the best source of Vitamin D (96.66%). There are very few dietary sources of Vitamin D namely, fish oil, egg yolks and almost absent in vegetable sources. Exposure to sunlight is the main source of vitamin D since most of the population nowadays are spending most of their time inside, leading to vitamin D deficiency. Fortifying foods with Vitamin D is the universal approach to prevent deficiency. About 76 per cent knew that calcium and Vitamin D is necessary for teeth and bone development. A large number of consumers were familiar that vitamin A prevents blindness (78%) whereas, 20 per cent believes that it reduces the risks of certain cancers. Very few were acquainted that it improves immunity against diarrhoea (6%) and prevent respiratory tract infection (7.3%).

Antioxidant was not the new term for the consumers, most of them were aware of the term and its benefits. A large percentage of consumers knew that consumption of antioxidants helps in slowing down ageing (68.66%). About 41.33 per cent agreed that they increase immunity. Antioxidants help in reducing the risk of cataract was known by 24.66 per cent. Very few consumer (17.33%) were aware that antioxidants reduce the risk of stomach diseases. Hence the overall knowledge regarding micronutrients was average.

Table: 4.6 Consumers knowledge regarding micronutrients deficiencies

n=150

S. No.	Micronutrient deficiencies	<i>f</i>	%
1	Deficiency of Vitamin A causes night blindness	117	78
2	Deficiency of Iodine leads to impaired mental development in children	85	56.66
4	Deficiency of Vitamin C causes bleeding gums	93	62
5	Symptoms of anaemia		
i.	Tiredness and irritation	108	72
ii.	Paleness of eyes and skin	77	51.33
ii.	Low concentration	58	38.66
iv.	Spoon shaped nails	35	23.33

v.	Don't know	15	10
----	------------	----	----

Table 4.6 elaborates that most of the consumer were aware that deficiency of vitamin A causes night blindness (78%), contrary results were shown in a study of Seth *et al.* (2016). About 56.66 per cent had knowledge about iodine deficiency in children causes impaired mental development whereas 62 per cent agreed that low intakes of vitamin C cause bleeding gums. Charlton *et al.* (2012) reported that consumer had limited knowledge about the outcomes of iodine deficiency.

The Table 4.6 also depicts that 72 per cent of consumers were aware that tiredness and irritation are one of the symptoms of anaemia, whereas paleness of eyes and skin (51.33%) are due to the low iron status in the body. The low concentration power in doing work which is a symptom of anaemia was reported by 38.66 per cent of consumer. Only 23.33 per cent consumers knew that spoon-shaped nails are due to anaemia. About 10 per cent had no idea about the symptoms of anaemia.

Comparison of consumer's knowledge among different age groups and education qualification

Age and education qualification are major factors that influence the awareness level of any individual. Therefore, these two parameters were considered for the comparison. Table 4.7 depicts the comparison of knowledge scores with 3 categories of age groups and 4 categories of education qualification namely, secondary, senior secondary, graduate and postgraduate.

Age: The results reveal that overall there was a significant difference in the knowledge levels between different age groups.

It was observed that there is a large margin between the scores of group I and group II ($p \leq 0.01$), whereas nothing noticeable appears in group I and III. Similarly, group II and III are also non-significant.

Education qualification: Over all there was an appreciable difference in all the four categories. Statistically, there is a difference ($p \leq 0.01$) found between the knowledge scores of those who have attained education till secondary, graduation and post graduation whereas there was no significant difference found between individuals that have studied up to secondary and senior secondary education. Thus, from the finding, we can state that the level of education does affect the knowledge regarding fortified foods. Contrary results were seen in the findings of Kasankala *et al.* (2018) that

knowledge and awareness of food fortification were not affected by income, education qualification, and age of the Mother/Child Caretakers.

Table 4.7 Comparison of consumer knowledge among different age groups and education qualification using ANOVA

n=150

S. No.	Sample group	Knowledge Mean \pm SD	SE	f-value
1	Age group			
i.	Group I (25-36)	21 ^a \pm 8.99	0.89	8.59**
ii.	Group II (37-48)	13.43 ^a \pm 5.46	1.14	
iii.	Group III (49-60)	16.5 ^b \pm 9.25	1.89	
2	Education qualification			
i.	Secondary	8.27 ^a \pm 1.56	0.47	12.83**
ii.	Senior secondary	13.6 ^b \pm 5.13	2.29	
iii.	Graduate	16.48 ^a \pm 6.57	0.96	
iv.	Post graduate	22.01 ^a \pm 9.35	1.00	

SE- Standard Error; SD-Standard deviation; **significant difference; a and b- Different superscript means statistically different

4.2 PERCEPTION OF CONSUMERS REGARDING FORTIFIED FOODS

Consumer Perception is the way that customers usually view, believe or feel about certain utilities and objects. Perception is the first impression that a person draws and on the basis of it select and interpret information to form a meaningful idea of the surrounding (Munnukka, 2008).

An attempt was made to assess the perception of the consumers about the fortified food based on the 25 perception statements. These statements were divided into four

categories namely Nutrition and Health, Safety and Risks, Consumption and Comparison with other Foods.

4.2.1 Consumer Perception towards fortified foods regarding nutrition and health

In this section 8 statements regarding nutrition and health were presented, the consumers were given the choice to either strongly agree or agree or neutral or disagree or strongly agree with the statements.

The findings from table 4.8 and Figure 4.2 reveal that 39 per cent consumers agreed that fortified foods are nutritious. About 36 per cent consumers gave mixed responses (agree and neutral) that they have added vitamins and minerals. Helps to cure micronutrient deficiency is moderately agreed by 37 per cent consumer. Pounis *et al.* (2011) stated that 81.4 per cent consumers believed that to combat the deficiency of iron one should do modification in their diet and few believed that they should use fortified foods. Majority of consumer (41%) agreed that health-conscious people buy them. Though most of the people (47%) gave a neutral response that they are complete food and 38 per cent disagreed with the statement. But 36 per cent did not agree that fortified foods should be daily recommended. About 47 per cent agreed that fortified products are food supplements. Most of them disagreed that (49%) fortified foods are from animal sources. Food Fortification Resource Centre (2018) clearly mentioned that the fortificants are extracted from only plant sources.

The results were also in conformity with the findings of Latha (2014). She reported that the majority of consumer strongly agreed that fortified foods are enriched with vitamins and minerals. More than half of the consumers strongly believed that fortified foods are healthy. Fortified foods help to treat nutritional deficiencies was moderately agreed by the majority of the customers. Most of the customers (61%) disagree with the statement that fortified foods are a balanced diet.

Thus overall results of perception regarding nutrition and health revealed that fortified foods are nutritious as they have added vitamins and minerals which helps to cure micronutrient deficiencies. They are not the complete food they just bridge the gap between the need and the actual consumption of required micronutrient through food.

Table 4.8 Percent distribution of consumers towards perception of fortified food regarding nutrition and health

n=150

S.No	Nutrition and Health	Strongly agree <i>f</i> (%)	Agree <i>f</i> (%)	Neutral <i>f</i> (%)	Disagree <i>f</i> (%)	Highly disagree <i>f</i> (%)
1	Fortified foods are nutritious.	19 (12.7%)	59 (39.3%)	64 (42.7%)	6 (4%)	2 (1.3%)
2	Fortified foods helps to cure micronutrient deficiency.	30 (20%)	56 (37.3%)	55 (36.7%)	9 (6%)	0 -
3	Fortified foods have added vitamins and minerals.	42 (28%)	54 (36%)	54 (36%)	0 -	0 -
4	Health conscious people buy fortified foods.	24 (16%)	61 (40.7%)	41 (27.33%)	24 (16%)	0 -
5	Fortified product is a complete food.	4 (2.66%)	15 (10%)	66 (47.14%)	57 (38%)	8 (5.33%)
6	Fortified foods should be daily recommended.	2 (1.33%)	44 (29.33%)	48 (32%)	54 (36%)	2 (1.33%)
7	Fortified products are food supplements.	8 (5.33%)	71 (47.33%)	48 (32%)	11 (7.33%)	12 (8%)
8	Fortified foods are from animal sources.	0 -	8 (5.33%)	42 (28%)	73 (48.66%)	27 (18%)

4.2.2 Consumer perception towards fortified regarding safety and risks

Analysis of the table 4.9 and Figure 4.3 reveals that 47 per cent consumers do not agree that fortified foods are not recommended to pregnant women while 37 per cent agreed that they are safe for lactating women. Nowadays various brands are voluntarily fortifying foods for pregnant and lactating women whereas fortified milk powder for babies is in trend. Hence it is totally safe for their consumption (only without any complications) Majority agreed that these are safe for infants (38%). Whereas 55 per cent gave neutral responses that these products are synthetic and can cause allergy. The consumption of these products is totally safe as they are extracted from natural or nearly natural sources of micronutrients. Latha (2014) reported that fortified foods are natural & organic and is been moderately agreed by the consumers.

A group of sample consumers (39%) were neutral with the statement that excessive consumption of fortified foods has health benefits. Since the fortified products fulfil 30-50 per cent of daily requirements of micronutrients, hence excessive consumption of these foods has no adverse effect on the body.

Truzyan *et al.* (2009) stated that some consumers had wrong perception or misconception about fortified foods like; it is harmful to eat fortified bread daily as the iron may accumulate inside the body and causes bad health effects. Some said fortified foods have added artificial micronutrients. Thus overall findings revealed that fortified foods are safe for every individual (without any complication).

Table 4.9 Consumer perception towards fortified regarding safety and risks

n=150

S. No.	Safety And Risks	Strongly agree <i>f</i> (%)	Agree <i>f</i> (%)	Neutral <i>f</i> (%)	Disagree <i>f</i> (%)	Highly disagree <i>f</i> (%)
1	Fortified foods are not recommended to pregnant women.	6 (4%)	25 (16.7%)	44 (29.3%)	71 (47.3%)	4 (2.66%)
2	Fortified foods are safe for lactating women.	9 (6%)	56 (37.3%)	52 (34.7%)	32 (21.3%)	1 (0.66%)
3	Fortified foods are safe for infants.	7 (4.7%)	57 (38%)	49 (32.7%)	35 (23.3%)	2 (1.33%)
4	Fortified foods causes allergy.	1 (0.7%)	34 (22.7%)	82 (54.7%)	32 (21.3%)	1 (0.66%)
5	Fortified foods are synthetic.	4 (2.7%)	38 (25.3%)	82 (54.7%)	23 (15.3%)	3 (2%)
6	Excessive consumption of fortified foods have health benefits.	4 (2.7%)	28 (18.7%)	59 (39.3%)	48 (32%)	11 (7.3%)

4.2.3 Consumer Perception towards the consumption of fortified foods

The Table 4.10 depicts the statements regarding the consumption of fortified foods by different sections of society. A major percentage of sample disagreed on all the perception statements. 59 per cent disagreed that fortified foods are for the diseased person, also 61 per cent did not that agree that fortified foods are for aged people. 71

per cent were not in the favor or disagreed that these are for athletes. Further majority of them also disagreed (52%) that they are consumed by poor people.

Thus the whole analysis concludes that a greater number of consumer disagreed that fortified food is for sick, old, athletes and lower class people. Hidden hunger was once the case or rural areas or seen in poor people, but today even in urban population suffering from hidden hunger. Due to ignorance, unawareness or modernization. People are more inclined towards junk and cheap food and spent most of their time inside or in front of computer screens, which give rise to many deficiency diseases like anaemia, softening of bones, and rickets in children, night blindness, etc. Thus fortified food can be consumed by all the section of population rich or poor, diseased or diseased free, aged or young people.

Table 4.10 Consumers perception regarding consumption of fortified foods

n=150

S. No.	Consumption	Strongly agree <i>f</i> (%)	Agree <i>f</i> (%)	Neutral <i>f</i> (%)	Disagree <i>f</i> (%)	Highly disagree <i>f</i> (%)
1	Fortified foods are for diseased person.	4 (2.7%)	10 (6.7%)	33 (22%)	88 (58.7%)	15 (10%)
2	Fortified foods are for aged people.	4 (2.7%)	15 (10%)	26 (17.3%)	91 (60.7%)	14 (9.3%)
3	Fortified foods are for athletes.	2 (1.3%)	14 (9.3%)	37 (24.7%)	71 (47.3%)	26 (17.3%)
4	Fortified foods are for low class people.	5 (3.3%)	2 (1.3%)	34 (22.7%)	78 (52%)	31 (20.7%)

4.3.4 Consumers Perception of fortified foods when compared with other foods

Form the Table 4.11 it is evident that 35 per cent consumers strongly agreed that fortified foods are costlier, whereas they gave neutral responses that fortified foods taste better (96%), there is no difference in color (51%), are more acceptable than unfortified foods (51%) and are cooked in same way as unfortified foods (45%).

People agreed that fortified foods are easily available in local departmental stores (49%). Since fortification is done mostly on staple foods or foods that are widely consumed by the population, so they are easily available. Iodised salt is easily available in any retail outlets at a very low cost of around `20/kg. Whereas other

fortified foods namely fortified Oil, fortified milk, fortified wheat flour, and rice are in consumers reach and are quite affordable. People disagreed that there is no difference in fortified foods and other foods (45%). While doing fortification only those minerals and vitamins are considered, that do not change the appearance, taste, texture, and flavor of the food.

Sometimes micronutrients are encapsulated to prevent reaction between micronutrients or between the micronutrient and the atmosphere, whereas its cost ranges from 7 paise to 2 rupees depending on the type and number of micronutrients added and the staple food that is being fortified (Food fortification Resource Center, 2016).

As per Copenhagen Consensus (2008), one rupee spent on fortifying food products will yield nine rupees which will be beneficial for the economy. Hence it is not a costly decision.

Table 4.11 Consumer perception of fortified foods when compared with other foods

n=150

S. No.	Comparison With Other Foods	Strongly agree f (%)	Agree f (%)	Neutral f (%)	Disagree f (%)	Highly disagree f (%)
1	Fortified foods are costlier.	52 (34.7%)	27 (18%)	40 (26.7%)	27 (18%)	4 (2.7%)
2	Fortified foods tastes better.	3 (2%)	9 (6%)	144 (96%)	23 (15.3%)	1 (0.7%)
3	There is no difference in colour.	9 (6%)	22 (14.7%)	77 (51.3%)	42 (28%)	0 -
4	There is no difference in fortified foods and other foods.	1 (0.67%)	12 (8%)	14 (9.33%)	67 (44.7%)	29 (19.3%)
5	Fortified foods are more acceptable than unfortified foods.	4 (2.7%)	38 (25.3%)	76 (50.67%)	30 (20%)	2 (1.3%)
6	Fortified foods are easily available in local departmental stores.	13 (8.7%)	73 (48.7%)	30 (20%)	29 (19.3%)	5 (3.3%)
7	Fortified foods are cooked in same way as unfortified	9 (6%)	59 (39.3%)	67 (44.6%)	14 (9.3%)	1 (0.7%)

foods.					
--------	--	--	--	--	--

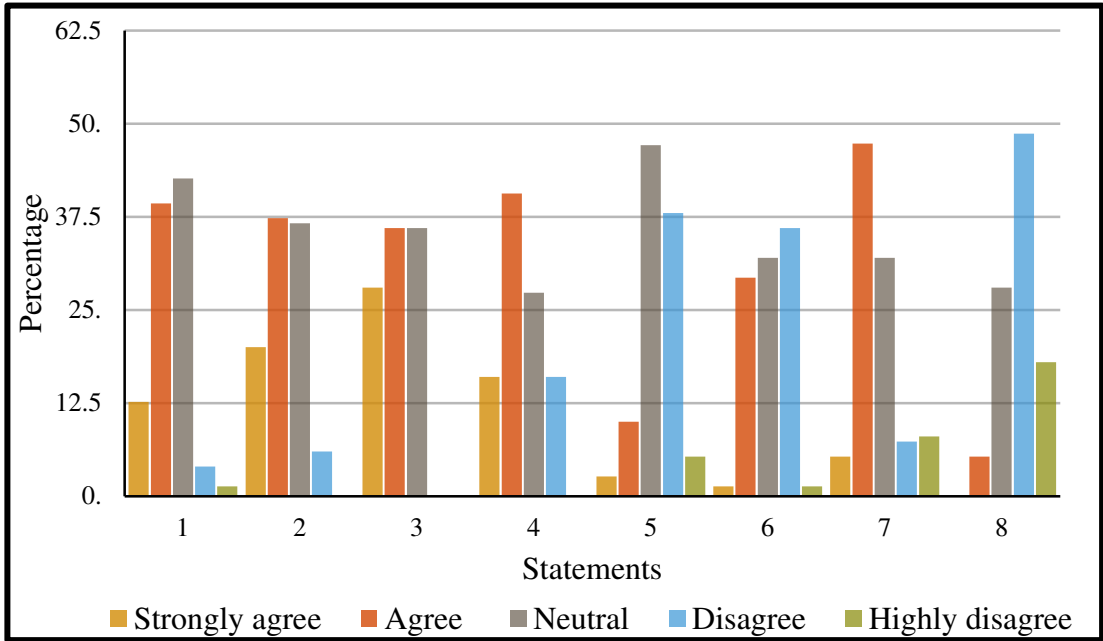


Figure 4.2 Consumer perception regarding nutrition and health aspect of fortified foods

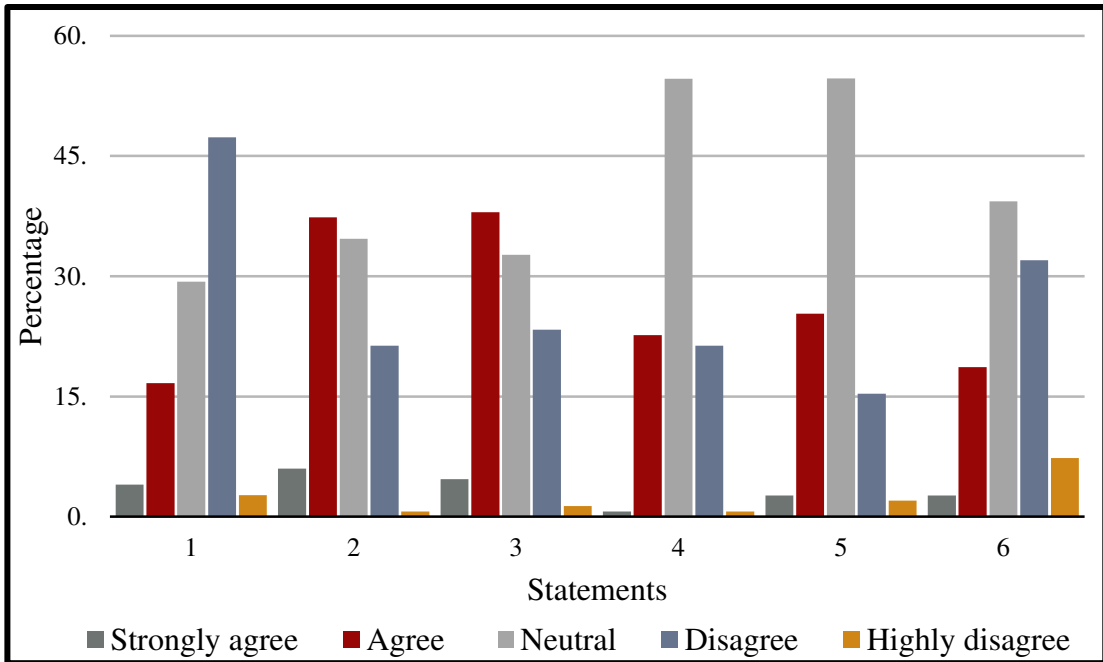


Figure 4.3 Consumer perception regarding safety and risks aspect of fortified foods

4.4 EXISTING PRACTICES OF CONSUMERS REGARDING CONSUMPTION OF FORTIFIED FOODS.

In this study, practice refers to the habit of doing or not doing certain things in routine life. In this section consumers, existing practices about fortified food were assessed. Since the fortification of salt with iodine is mandatory in India and almost all brands of oil are fortified, so the consumption of fortified food was 100 per cent among consumer.

Table 4.12 Factors considered while purchasing and not purchasing fortified foods

n=150

S.No.		Reasons	<i>f</i>	%
1	Reasons of purchasing	• Added nutrients	46	30.66
		• To keep healthy lifestyle	37	24
		• Influenced by family/ Friends/media	20	13.33
2	Reasons of not purchasing	• Not aware of it	53	35.33
		• Not safe/ Synthetic	23	15.33
		• Not easily available	14	9.33

Besides salt and oil, there are other fortified foods available in the market such as fortified milk, health drinks, breakfast cereals, biscuits, fruit juices, etc. (Table 4.12) consumer were asked about the reason of purchasing fortified foods, 30.66 per cent responded that they have added nutrients, 24 per cent said to keep a healthy lifestyle and about 13.33 per cent said that they are influenced by media. When consumers asked about the reason for not buying fortified foods, 35.33 per cent said that they are unaware about it, some considered them unsafe or synthetic (15.33%) and few stated that they are not easily available (9.33%). Latha (2014) reported that the major factors while purchasing any food product is its health benefits, nutritive content, and taste.

Table 4.13 Label reading practices of consumer

n=150

S. No.	Label reading practice	<i>f</i>	%
1	Always	109	72.67

2	Occasionally	41	27.33
3	Never	0	0

Scrutiny of the table 4.13 revealed that the majority of consumers have the habit of reading food label always. Whereas 27.33 percent occasionally reads the label. The results also congruent with the finding of Vermula (2012), Washi (2012) and Upadhaya (2016),

Table 4.14 Type of information checked by the consumers on ingredient panel

n=150

S. No.	Information	<i>f</i>	%
1	Price	147	98
2	Manufacturing or expiry date	147	98
3	Brand name	132	88
4	Net quantity	126	84
5	Storage instructions	100	66.66
6	Nutritional content	79	52.66
7	Ingredients	73	48.66
8	Fortified labels	4	2.66

Table 4.14 reflects that all most all consumers were conscious while buying food products. Majority of them (98%) check price and manufacturing or expiry date, followed by 88 per cent check brand name. Whereas 84 per cent notices the net quantity of the product. Storage instruction (66.66%), nutritional content (52.66%) and ingredients (48.66%) were also checked by consumers while buying any food products. Only a few (2.66%) reported that they read fortified labels.

Table 4.15 Source of information about fortified food products

n=150

S.No.	Source of Information	<i>f</i>	%
1	Seen, heard and read advertisements	68	45.33
i.	Television	52	76.47
ii.	Newspaper	42	61.7
iii.	Magazines	14	20.58
iv.	Internet	14	20.58
v.	Health centres	6	8.82

Scrutiny of the table 4.15 reflects that only 45.33 per cent of consumers had seen, read or heard the advertisements about fortified food products. Television was the major source of information (76.47%) followed by the newspaper (61.7%). About 20.58 per cent of consumers reported magazine and internet were their sources of information, whereas only 8.82 per cent respondent's source of information was the health centre.

Table 4.16 Recommended promotion means of fortified foods by the consumers

n=150

S. No.	Promotion of Fortified Food	<i>f</i>	%
1	Fortified foods should be promoted	127	84.66
i.	Through advertisement	97	76.37
ii.	Distribution of folders in public places	44	34.64
iii.	Through awareness campaigns	36	28.34
iv.	As a part of curriculum in schools/colleges	29	22.83
v.	Online media	10	7.87

Table 4.16 elaborates that about 84.66 per cent consumer agreed that fortified foods should be promoted through various promotion techniques namely through advertisement (76.37%), distribution of folder on public places (34.64%), through awareness campaigns (28.34%), as a part of curriculum (33.83%) and through online media (7.87%). The reasons for promotion stated by participants were added nutrients hence nutritious (74.80%) and they prevent various micronutrient deficiencies (25.20%). About 23 (15.33%) consumers were not in the favor that they should be promoted. Fortified foods are artificial or synthetic was the response for not publicizing them.

Table 4.17 Preferred brands of fortified food products

n=150

S.No.	Food product	Preferred Brands	<i>f</i>	%
1	Wheat Flour	Golden harvest (fortified)	0	0
		Ashirwad chakki atta (Unfortified)	77	51.33
		Freshly grounded (unfortified)	62	41.33
		Other (unfortified)	11	7.33
2	Milk	Saras (fortified)	97	64.67
		Amul (fortified)	53	35.33
3	Oil	Fortune sunflower oil	59	39.33
		Engine mustard oil	47	31.33
		Fortune soya health	38	25.33

		Other	6	4
4	Salt	Tata iodised salt	125	83.33
		Ashrivad iodised salt	17	11.33
		Other	8	5.34
5	Health drinks	Bournvita	54	36
		Horlicks	22	14.67
		Complain	8	5.33
		Not consuming	66	44
6	Breakfast cereal	Kellogg's corn flakes	19	12.67
		Kellogg's chocos	6	4
		Kellogg's (Muesli fruit and nut)	8	5.33
		Not consuming	117	78

Wheat flour: The data in the Table 4.17, reveal that that none of the consumer was consuming fortified wheat flour. Majority of consumers preferred Ashirwad chakki atta (51.33%) as their daily consuming wheat flour brand (unfortified). Most of the consumer stated that good taste and trusted brand are the reasons for their consumption. Whereas 41.33 per cent consumers choose freshly grounded wheat flour due to its good taste and purity. About 7.33 per cent consumers preferred other wheat flour brands like Patanjali, Laxmi blog flour and nature fresh.

Milk: In the dairy sector majority of consumers prefer Saras milk (64.67%) followed by Amul (35.33%). These are considered as trusted, clean, without any adulteration and of high quality by the consumers.

Salt: Salt is the most essential ingredient in every cookery, as it enhances the taste of the food. Since iodised salt is consumed by all the section of the population, majority of consumers prefer Tata iodised salt (83.33%), whereas 11.33 per cent subject prefer Ashrivad as their salt brand.

Health drinks: Among health drinks, Bournvita was the most preferred brand accounting to 36 per cent consumers followed by Horlicks (14.67%) and complain (5.33%). Whereas a large sample does not consume health drinks on a daily basis (44%).

Breakfast cereal: Among health drinks, Bournvita was the most preferred brand accounting to 36 per cent consumers followed by Kellogg's (Muesli fruit and nut) (5.33%) and Kellogg's chocos (4%). Kellogg's is the international brand and is been in the market from a quiet long time. The company spends a lot of its money on advertisements and promotions, therefore the most popular brand among consumers.

Thus it can be stated that the Ashirwad chakki atta (Unfortified), Saras, Fortune, Tata, Bournvita and Kellogg's were the highest preferred brands in each of the product categories of fortified foods.

Table 4.18 Frequency of consumption of fortified foods

n=150

S. No.	Fortified Food product	Daily <i>f (%)</i>	In a week <i>f (%)</i>	Twice in a week <i>f (%)</i>	Fortnightly <i>f (%)</i>	Never <i>f (%)</i>
1	Wheat flour	0	0	0	0	150 (100%)
2	Salt (iodised)	150 (100%)	0	0	0	0
3	Oil	150 (100%)	0	0	0	0
4	Milk	74 (49%)	36 (24%)	21 (14%)	19 (12.67%)	0
5	Health drink	51 (34%)	18 (12%)	12 (8%)	3 (2%)	66 (44%)
6	Breakfast cereal	24 (16%)	9 (6%)	0	0	117 (78%)

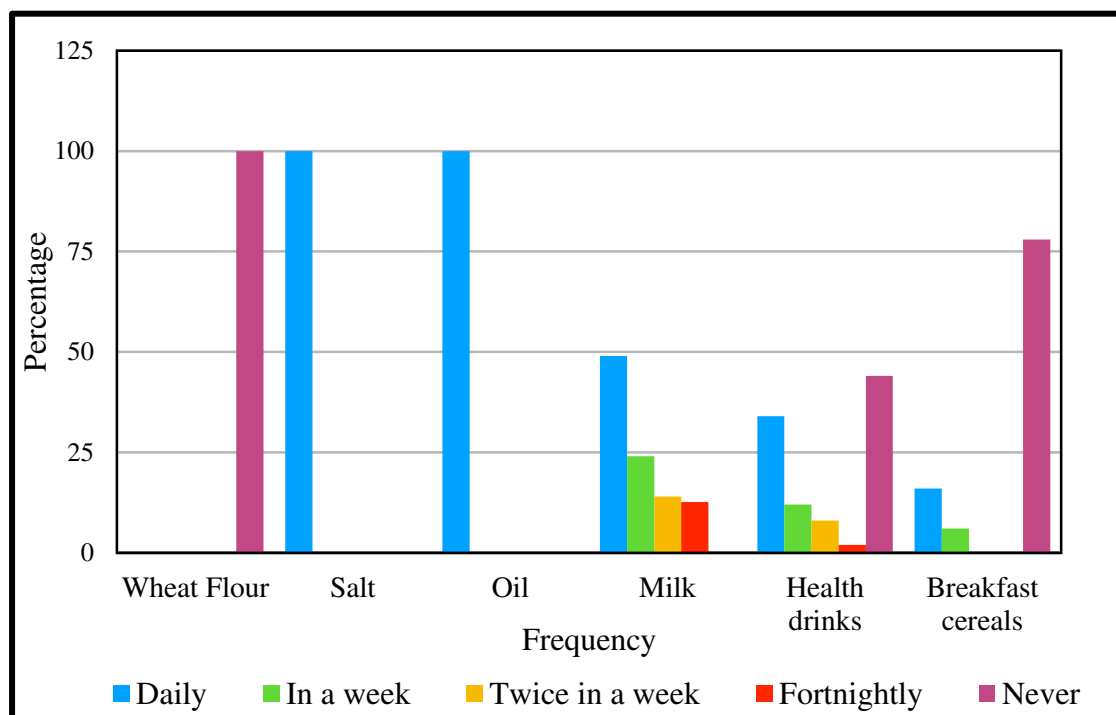


Figure 4.4 Fortified food frequency

- **Fortified wheat flour:** The data in the Table 4.18 reveals that none of the consumers were consuming fortified wheat flour, the reason could be unavailability in local departmental stores, unawareness or having a perception that they are artificial or expensive.
- **Salt and edible vegetable oil:** They are a very important component of cooking food and adds taste to it. Palm oil, rice bran oil, sunflower oil, soybean oil, olive oil, and groundnut oil are some examples of commonly consumed oil. Iodised salt and fortified oil were consumed by all the sample on a daily basis, as they both are mandatorily fortified.
- **Milk:** It was consumed daily by 49 per cent of consumer. About 36 per cent were consuming it once in a week. Milk was consumed twice in a week by 14 per cent of consumer. A total of 12.67 per cent prefer having fortified milk fortnightly.
- **Health drinks:** About 34 per cent were consuming health drinks daily, followed by 12 per cent and 8 percent prefer having them once and twice in a week. Only 2 per cent were consuming them fortnightly. A major percentage (44%) reported that they never consume health drinks.
- **Breakfast cereal:** Consumption of breakfast cereal was not very popular among the consumers, about 16 per cent were consuming them on a daily basis, whereas only 9 per cent prefer eating them once in a week. A group of a large sample (78%) never consumes breakfast cereals.

4.5 CONTRIBUTION OF MICRONUTRIENTS THROUGH FORTIFIED FOODS

Table 4.19 depicts that all the consumers didn't consume all the fortified food on a particular day, so the micronutrient contribution was calculated each for particular food products namely salt, oil, milk, health drinks, and breakfast cereal separately. One day 24-hour recall of fortified food was done to calculate the nutrient contribution. RDA of moderate working women was used as the reference value as most of the consumers were of working classes.

Salt: Salt is mandatorily fortified in India from the last six decades as Iodine Deficiency Disorders has been the major public health problems in the country. Results showed that the mean intake of iodine was 102 ± 26.46 , which was meeting 68 per cent requirement of RDA.

Pastorelli *et al.* (2015) stated that daily consumption of 5gm of salt iodized at 30mg/kg was adequate to meet the iodine intake in the adult population.

Oil: From the past few years, several oil brands started to manufacture fortified oil to combat vitamin A and D deficiencies, namely Fortune, Saffola, Engine, Sundrop. The daily mean intake of Vitamin A was 211 ± 28.96 which was meeting 35 per cent requirement of Recommended Dietary Allowances. Whereas mean intake of Vitamin D was 2.92 ± 0.81 which was fulfilling 29.2 per cent of RDA requirement.

Laillou *et al.* (2012) also documented the similar results that vitamin A fortified vegetable oil provide around 21–24 per cent for VRDA (Vietnam Recommended Dietary Allowances).

Milk: Milk is nature's nearly complete food consisting of all the essential nutrients needed for one well-being. Benefits of fortifying milk with Vitamin A and D includes prevention of deficiency diseases like night blindness and osteoporosis and ability to reach out a significant proportion of population globally, so the acceptance of dairy products among people is high. About 49 per cent of consumers were consuming fortified milk with the mean intake of vitamin A was 107.21 ± 60.44 , which was contributing 17.8 per cent requirement of vitamin A . Whereas the daily mean intake of vitamin D was 1.13 ± 0.25 , thereby meeting the 11.3 per cent of RDA requirement.

Bhawana (2012) developed the iron and vitamin A fortified milk. The optimum fortification level in milk was 25 ppm iron and 2500 IU/L vitamin A acetate. Fortified milk of amount 250 ml will contribute to 30-35 per cent of Vitamin A and iron requirement daily.

Health drinks: From the last decades the market of health drinks expended quite well. Several brands are fortifying their flavouring powder with various nutrients to overcome the deficiencies. Most of the consumers purchase health drinks for its taste

but they are unaware of the essential nutrients they are getting. They are fortified with calcium, zinc, iron, folate, iodine, vitamin A, D, B etc. From the data it was revealed that mean intake of vitamin A (85.50 ± 38.86), Vitamin D (0.80 ± 0.41), vitamin B12 (0.25 ± 0.11), vitamin C (14.25 ± 7.9), iron (3.7 ± 1.78), folate (26.88 ± 20.59), calcium (51.63 ± 50.51), zinc (0.495 ± 0.22) and iodine (16.54 ± 7.42) through health drinks was meeting 14.25 per cent, 8 percent, 25 per cent, 35.62 per cent, 17.6 per cent, 13.44 per cent, 4.95 per cent and 11.02 per cent requirement of RDA respectively.

Breakfast cereals: Eating breakfast cereal was not very common practice among consumers. Only 16 per cent of consumer were consuming them. The table reveal that the daily mean intake of vitamin A (23.88 ± 5.82), Vitamin C (6.13 ± 2.83), vitamin B12 (0.07 ± 0.02), folate (16.61 ± 6.20) and iron (3.29 ± 1.53) was meeting the 4 per cent, 15.32 per cent, 7 per cent, 8 per cent and 15.66 per cent requirement of RDA of respective nutrients.

Fortified breakfast cereals were the largest contributor of folate and iron intake, and fortified milks the largest contributor to intakes of vitamin A and D (Fulgoni and Buckley, 2015)

Similar results were in seen in Hannon and Flynn (2007). They found that fortified breakfast cereals contributed to intakes of iron, folate and B-vitamins.

Gibson (2003) reported that increased breakfast cereal consumption positively associated with greater intakes of iron, folate, vitamin D, calcium, B-vitamins and zinc among children.

Thus, it is concluded that fortified foods fulfil the daily 18.40 ± 14.84 nutrient requirement of various micronutrients. None of the fortified food was exceeding the micronutrient intake above the reference values. As it is not the replacement of a balanced diet, consumption of food rich in vitamins and minerals like fruits, vegetables, milk and its products, cereal, pulses should be given top priority. But in this scenario consuming a balanced diet is not easy to achieve by every segment of the population so the consumption of fortified foods should be recommended as they are an inexpensive and effective approach to combat hidden hunger.

Table 4.19 Nutrient contribution of fortified foods

n=150

S.No	Food products	f (%)	Nutrients	RDA*	Per day nutrient intake (Mean±SD)	Difference of RDA and Nutrient intake	% Contribution
1	Salt	150 (100)	Iodine	150µg	102±26.46	48µg	68
2	Oil	150 (100)	Vitamin A	600µg	211±28.96	389µg	35
			Vitamin D	10µg	2.92±0.81	7.08µg	29.2
3	Milk	74 (49)	Vitamin A	600µg	107.21±60.44	492.79µg	17.8
			Vitamin D	10µg	1.13±0.25	8.87mg	11.3
4	Health drinks	51 (34)	Vitamin A	600µg	85.50±38.86	514.5mcg	14.25
			Vitamin D	10µg	0.80±0.41	9.2µg	8
			Vitamin B12	1µg	0.25±0.11	0.75µg	25
			Vitamin C	40mg	14.25±7.9	25.75mg	35.62
			Iron	21 mg	3.7±1.78	17.3mg	17.6
			Folate	200µg	26.88±20.59	173.12µg	13.44
			Calcium	600mg	51.63±50.51	548.37mg	8.6
			Zinc	10mg	0.495±0.22	9.505mg	4.95
			Iodine	150µg	16.54±7.42	133.46µg	11.02
5	Breakfast cereals	24 (16)	Vitamin A	600µg	23.88±5.82	576.12µg	4
			Vitamin C	40mg	6.13±2.83	33.87mg	15.32
			Vitamin B12	1µg	0.07±0.02	9.93µg	7
			Folate	200µg	16.61±6.20	183.39µg	8
			Iron	21mg	3.29±1.53	17.71mg	15.66

Source: RDA*- Recommended Dietary Allowances, NIN- 2010

4.6 DEVELOPMENT OF FOLDER ON IMPORTANCE OF FORTIFIED FOODS

A folder was developed on importance of fortified foods which included information regarding food fortification, hidden hunger, various fortified products, importance of several micronutrients like iodine, iron, vitamin A, D, B. The folder was later evaluated by 10 panel member based on 6 criteria on 5 point rating scale, ranges from excellent (5), very good (4), good (3), (fair) 2 and poor (1).

Table 4.20 Mean scores given by experts on developed folder

n=10

S.No.	Particulars	Scores
1.	Content	4.1±0.56
2.	Accuracy	4.2±0.42
3.	Language clarity	4.2±0.42
4.	Suitability to the consumer	4.5±0.70
5.	Layout and Design	4±0.47
6.	Overall presentation	4.2±0.42

***Scores: 5: Excellent, 4: Very good, 3: Good, 2: Fair, 1: Poor; SD: Standard Deviation**

Table 4.20 depicts the mean score given by the panel of experts on 6 differs criteria namely, content (4.1±0.56), accuracy (4.2±0.42), language clarity (4.2±0.42), the suitability of consumer (4.5±0.70), layout and design (4±0.47) and overall presentation (4.2±0.42). According to the 5 point scale overall score was in the range of 4 (very good). The highest score was for its suitability of the subject. Thus the folder can be used as informational material to impart awareness among the sample (female consumers).

SUMMARY

Deficiencies of vitamin and mineral affect billions of people worldwide and are especially prevalent in developing countries like India. Its consequences are long lasting and devastating. These deficiencies contribute to the vicious cycle of malnutrition, underdevelopment and poverty. A very large section of our society especially adolescent boys and girls, women are still malnourished. Poor physical or mental growth of children becomes apparent in their lack of concentration which decreases their interests in studies and they avoid attending the schools leading to poor attendance and low retention levels at the school. Low consumption of lentils, animal and fish products, fruits and vegetables all of which are rich sources of vitamins and minerals leads to micronutrients deficiencies. There are many strategies to combat malnutrition, food fortification is one such strategy to eradicate this hidden hunger. It has been scientifically proven that food fortification is a timely intervention that can address the challenges of malnutrition. Food fortification is the adding of vitamins and minerals in minute quantity in the commonly consumed foods like milk, rice, wheat, oil. Fortifying food staples with iron, iodine, zinc, vitamin A, D is an easily available, affordable and effective way to prevent nutritional deficiencies at mass level. It is grossly under-utilised strategy in the developing countries due to lack of awareness.

A study entitled **“Assessment of Consumer Knowledge, Perception, Practices Towards Fortified Foods and their Nutrient Contribution”** was carried out with the objectives to assess consumer knowledge and perception regarding fortified foods, to find out existing practices of consumers regarding consumption of fortified foods, to assess the contribution of nutrients through fortified foods and to develop information material on Fortified Foods. The research was delimited to female consumers of age 25 and above residing within the Udaipur city, Rajasthan.

A sample of total 150 female consumers was selected from 5 supermarkets, selected randomly from a list of supermarkets located in different parts of Udaipur. Questionnaire technique was used to gather data from the consumer. Total 30 consumers each from 5 supermarkets were chosen and questionnaires were distributed among them. Background information questionnaire was prepared to obtain basic details about the consumer. The information included their name, age, religion, caste,

education qualification, occupation, marital status, type of family, family income, food habits, health related issues, intake of food supplements or not. A questionnaire was developed to assess the knowledge of food fortification. Questions regarding the concept, advantages, health benefits and logo, various fortificants, micronutrients deficiencies, role of micronutrients were included in this section. Each correct response was assigned a score one each and incorrect as zero. To assess the consumer perception towards fortified foods a total of 25 Statements were prepared. They were divided into four sections namely nutrition and health, safety and risks, consumption and comparison with other foods. Statements were both negative and positive i.e., fortified products are complete food, fortified foods are synthetic, fortified foods helps to cure micronutrient deficiencies, etc. Consumers were given choices to either strongly agree/agree/neutral/disagree/highly disagree with the statements. To find out the existing practices of consumers regarding consumption of fortified foods, information was gathered regarding the consumption, reasons of purchasing, label reading practices, preferred brands, etc.

A fortified food product list of various food products like milk, oil, wheat flour, breakfast cereals, health drinks was prepared from which consumers were asked about the amount they consume and how frequently they are consuming them (daily/once in a week/ twice in a week/ fortnightly/never). One day recall of micronutrients were calculated from the quantity consumed which were then compared with the RDA (Recommended Dietary Allowance) to calculate the nutrients contribution in the diet. A folder on importance of fortified foods was developed in order to fulfil the fourth objective of the present research. Relevant information was gathered from various authentic online sources, literatures, magazines, books, for the content of the folder. The developed folder was subjected for evaluation by a panel of 10 experts. It was evaluated on the basis of 6 criteria: content, accuracy, language and clarity, suitability of the consumer, layout and design and overall presentation.

Results revealed that majority (68.67%) of the consumers were in the age range of 25-36 years, whereas only few (16%) were in the age category of 49-60 years. About 78 per cent were Hindu. Whereas only 5.3 per cent were Christian. About 78 per cent belonged to general category, followed by 8.3 per cent were of scheduled caste, 6 per cent belonged to scheduled tribe and 7.3 per cent were of other

backward class. Most of them were postgraduates followed by 30.7 per cent were graduates, 7.3 per cent were secondary passed and 4 per cent had the education qualification up to senior secondary. Nearly 19 per cent consumers were students, around 13 per cent were in government sector, and 28.7 per cent were from private sector, whereas 5.3 percent and 33.3 per cent of consumers were homemakers and unemployed respectively. Majority of them were married (68.7%), whereas 31.3 per cent were unmarried. Consumers belonging to nuclear families were 52 per cent whereas 48 per cent consumers were from joint families. Most of the consumers (44.67%) monthly family income was in the range of 20000-40000, followed by 37.33 per cent were in the category of 47000-73000 and only 18 per cent were belonged in the range of 74000-100000. It was also revealed that 11.33 per cent consumers were hypertensive, 9.3 per cent obese followed by diabetic (6%) and 4.7 per cent had hypothyroidism. No health issues were reported by 68.7 per cent of consumer. Findings shown that 20 per cent consumer were consuming dietary supplements namely, multivitamins and minerals, protein powders, iron, calcium and Vitamin D supplements. Majority of consumers had poor knowledge (52%) regarding fortified food products. Whereas 36 percent consumers had average knowledge. Only 12 per cent had good knowledge about fortified foods. About 51.33 per cent of consumer were aware of the term food fortification. Very few consumer were familiar with the fortified logo (15.33%). Majority of consumers (95.33%) had knowledge that iodine is fortified in salt whereas very few (4.67%) were aware about the double fortified salt. All the consumers had knowledge about various vitamins and minerals (100%). The significant difference between the knowledge score of different age groups ($p \leq 0.01$) and between the knowledge scores of educational qualification of consumers.

The findings revealed that 39 per cent consumers agreed that fortified foods are nutritious. About 36 per cent did not agreed that fortified foods should be daily recommended. Total 35 per cent consumers strongly agreed that fortified foods are costlier, whereas they gave neutral responses that fortified foods tastes better (96%), there is no difference in colour (51%), are more acceptable than unfortified foods (51%) and are cooked in same way as unfortified foods (45%).

About 127 (84.66%) consumer agreed that fortified foods should be promoted through various promotion techniques namely through advertisement (76.37%),

distribution of folder on public places (34.64%), through awareness campaigns (28.34%), as a part of curriculum (33.83%) and through online media (7.87%). Majority of them (98%) check price and manufacturing or expiry date, whereas, only a few (2.66%) reported that they read fortified labels. None of the consumer was consuming fortified wheat flour. Majority of consumers preferred Ashirwad chakki atta (51.33%) as their daily consuming wheat flour brand (unfortified). Most of the consumers prefer Saras milk (64.67%) followed by Amul (35.33%). Among health drinks, Bournvita was the most preferred brand accounting to 36 percent consumers. Whereas in breakfast cereals, Kellogg's corn flakes was the most preferred brand accounting to 12.67 per cent consumers. Contribution of iodine, vitamin A, D and C was more in the diets of the consumer. A folder was developed as an information material. Mean score given by panel members on each of the parameters: Content (4.1 ± 0.56), accuracy (4.2 ± 0.42), language clarity (4.2 ± 0.42), the suitability of consumer (4.5 ± 0.70), layout and design (4 ± 0.47) and overall presentation (4.2 ± 0.42).

CONCLUSION

From the findings, it can be concluded that the majority of consumer had low knowledge regarding fortified foods. Most of them were unaware of the term food fortification, its logo, and its advantages. Very few were aware of micronutrients that are fortified in food products. Majority of them knew about iodized salt, whereas very less had knowledge about fortified wheat flour, rice, milk, oil, and double fortified salt. As far as the perception of fortified foods concerned, the majority gave mixed and neutral responses. They were unsure that fortified foods are nutritious, have added vitamins and minerals, or whether they help to cure micronutrient deficiencies. They disagreed that these should not be recommended daily, are from an animal source, and for diseased or aged or low- class people. None of the consumer were consuming fortified wheat flour. In the dairy sector, Saras was the most preferred brand, followed by fortune oil brand. Very few were consuming fortified health drinks and breakfast cereals, in these two categories Bournvita and Kellogg's were the most preferable respectively. Television was the major source of information. Vitamin A, D, C, and iodine were contributing more in the diet as these nutrients were present in more than one fortified food. Thus, it is concluded that people had poor knowledge and practices towards fortified food products.

The research highlighted that there is a need to have an accurate and sufficient knowledge regarding fortified foods, as these products help in preventing multiple micronutrient deficiencies as well as build up the vitamins and minerals stores in the body. It was the time when rural population was the most vulnerable section in our society in terms of nutrition, but due to modernisation and fast moving world, urban people too are facing many health challenges. Fortification of food is a very feasible and effective strategy to fight with the deficiency diseases like anaemia, goitre, rickets, and night blindness. Consuming fortified food does not require any change in diet, as vitamins and minerals are added in those food products they are widely eaten by the population such as staple foods. Tackling malnutrition requires a universal approach. Awareness can be created by distribution of folders in public places, promotion in health centres or a part of school/ college curriculum. Only integrated and joint efforts at all levels can help us fight malnutrition. With the increasing awareness about the advantages of fortified foods, India will slowly but surely move towards a country of healthier and happier people.

RECOMMENDATIONS

1. A comparative study between male and female consumers can be done to assess knowledge, perception and practices towards fortified foods.
2. A Comparative study to assess knowledge, attitude and practices among consumers and non-consumers of fortified foods.
3. Similar researches can be done across the states to find out the area specific differences.
4. Development of fortified foods as a supplementary meal for children, pregnant and lactating mothers to treat micronutrient deficiencies.
5. Efficacy of fortified food available in the market can be tested.
6. Development of intervention package to create awareness.
7. The folder developed under study should be used to create awareness among consumers.

BIBLIOGRAPHY

- Agrawal, A. and Varma, K. 2015. Diet and Nutrient Intakes in Urban Women of Rajasthan State, Northern India. *Ecology of Food and Nutrition*. **55**: 1-55.
- Andersson, M., Thankachan, P., Muthayya, S., Goud, R. B., Kurpad, A. V., Hurrell, R. F. and Zimmermann, M. B. 2008. Dual fortification of salt with iodine and iron: a randomized, double-blind, controlled trial of micronized ferric pyrophosphate and encapsulated ferrous fumarate in southern India. *The American Journal Of Clinical Nutrition*. **88**:1378-1387.
- Bailey, R. L., Gahche, J. J., Lentino, C.V., Dwyer, J. T., Engel, J. S., Thomas, P. R., Sempos, C. T. and Picciano, M. F. 2011. Dietary Supplement Use in the United States. *Journal of nutrition*. **141**: 261-266.
- Battalwar, R. and Syed, B. F. 2016. A Study on Awareness and Consumption of Fortified Foods among Female Adults of Mumbai. P G Diploma thesis submitted to S.N.D.T. Women's University, Mumbai, India.
- Berner, L.A., Keast, D.R., Bailey, R.L. and Dwyer, J. T. 2014. Fortified foods are major contributors to nutrient intakes in diets of US children and adolescents. *Journal of the Academy of Nutrition and Dietetics*. **114**: 1009-1023
- Bhawana. 2012. Development and Evaluation Of Vitamin A And Iron Fortified Milk. Ph. D thesis submitted to the National Dairy Research Institute, Karnal
- Bromage, S., Gonchigsumlaa, E. and Magsar, B. 2019. Awareness and Attitudes Regarding Industrial Food Fortification in Mongolia and Harbin. *Nutrients*. **11**:201.
- Charlton, K., Axford, S., Gemming, L., Houweling, F., Goodfellow, A. and Ma, G. 2012. Poor Knowledge and Practices Related to Iodine Nutrition during Pregnancy and Lactation in Australian Women: Pre- and Post-Iodine Fortification. *Nutrients*. **4**: 1317-1327.

- Danielle, S. B. and Gazzaniga, M. S. 2011. Understanding complexity in the human brain. *Trends in Cognitive Sciences*. **15**: 200-209.
- Deshmukh, N. and Goyal, R. 2017. Food Label Reading Knowledge and Understanding Among Consumers. *International Journal of Nutrition, Pharmacology, Neurological Diseases*. **7**: 71-72.
- Douglas, L F. and Joanna, P. 2010. Product gender perceptions and antecedents of product gender congruence. *Journal of Consumer Marketing*, **27**: 251-261.
- Ekbote, V. H., Khadilkar, A. V., Chiplonkar, S. A., Hanumante, N. M., Khadilkar, V. V. and Mughal, M.Z. 2011. A pilot randomised controlled trial of oral calcium and vitamin D supplementation using fortified laddoos in underprivileged Indian toddlers. *European Journal of Clinical Nutrition*. **65**:440-446.
- Flour Fortification Initiative. 2012. Anaemia and Neural Tube Birth Defects Decline in Bahrain. Retrieved from http://www.ffinetwork.org/about/stay_informed/newsletters/Q4_21012.html on 23.11.2018.
- Food Agriculture Organization. 1996. Fortification of food with micronutrients and meeting dietary micronutrient requirements. Retrieved from <http://www.fao.org/tempref/AG/agn/nutrition/fortification.pdf> on 23/11/2018.
- Food and Nutrition Research Institute. 2014. Awareness and usage of fortified foods in the Philippines. Retrived from <http://www.fnri.dost.gov.ph> on 20/11/2018.
- FSSAI. 2016. Commodity Standards. Retrieved from https://ffrc.fssai.gov.in/ffrc/documents/doc/whats_new/Commodity%20Standards.pdf on 24/02/2019.
- FSSAI. 2018. Food fortification logo. Retrieved from https://ffrc.fssai.gov.in/ffrc/logo_specification on 24/02/2019.
- Fulgoni, V. L. and Buckley, R. B. 2015. The Contribution of Fortified Ready-to-Eat Cereal to Vitamin and Mineral Intake in the U.S. Population. *Nutrients*. **7**: 3949-3958.
- Gibson, S. 2003. Micronutrient intakes, micronutrient status and lipid profiles among young people consuming different amounts of breakfast cereals: further analysis

of data from the national Diet and Nutrition Survey of Young People aged 4 to 18 years. *Publication of Health Nutrition*. **6**: 815-820.

Glinz, D., Wegmüller, R., Ouattara, M., Diakité, V. G., Aaron, G. J., Hofer, L., Zimmermann, M. B., Adiossan, L. G., Utzinger, J., N’Goran, E. K. and Hurrell, R. F. 2017. Iron Fortified Complementary Foods Containing a Mixture of Sodium Iron EDTA with Either Ferrous Fumarate or Ferric Pyrophosphate Reduce Iron Deficiency Anaemia in 12- to 36-Month-Old Children in a Malaria Endemic Setting: A Secondary Analysis of a Cluster-Randomised Controlled Trial. *Nutrients*. **9**:759.

Gordoncillo, N. P., Talavera, M. T. M., Barba, C. V. C. and Quimbo, M. A. T. 2017. Knowledge and Use of Complementary Food Fortification with Multiple Micronutrient Powders in Selected Communities in the Philippines. *Malaysian Journal of Nutrition*. **23**: 191-198.

Gronborg, I. D., Tetens, T., Ege, M., Christensen, T., Wreford, E., Andersen, W. and Andersen, R. 2018. Modelling of adequate and safe vitamin D intake in Danish women using different fortification and supplementation scenarios to inform fortification policies. *European Journal of Nutrition*. **58**: 227-232.

Haas, J. D. Wenger, M. J., Kolb, L. E., Nevins, J. E. H., Venkatramanan, S., Reinhart, G. A. and Wesley, A. 2014. Consumption of a Double-Fortified Salt Affects Perceptual, Attentional, and Mnemonic Functioning in Women in a Randomized Controlled Trial in India. *The Journal of Nutrition*. **147**: 2297-2308.

Hannon, E.M. and Flynn, A. 2007. Contribution of ready-to-eat breakfast cereals to nutrient intakes in Irish children aged 5-12 years. *Proceedings of Nutrition Society*. **66**: 43.

Hoddinott, J., Rosegrant, M., Torero, M., Hunger and Lomborg, B. 2013. Costs and benefits. Cambridge University Press and Copenhagen Consensus Centre. New York. pp 332-367.

Jaeggi, T., Kortman, G. A., Moretti, D., Chassard, C., Holding, P., Dostal, A., Boekhorst, J., Timmerman, H. M., Swinkels, D. W., Tjalsma, H., Njenga, J., Mwangi, A., Kvalsvig, J., Lacroix, C. and Zimmermann, M. B. 2015. Iron fortification adversely affects the gut microbiome, increases pathogen

- abundance and induces intestinal inflammation in Kenyan infants. *Gut*. **64**: 731-742.
- Kasankala, M. L., Kitunda, M., Mushumbusi, D. G., Cyprian, C. M., Meghji, W. P., Mgoba, M. C. and Towo, E. 2018. Knowledge and Awareness on Food Fortification among Mother/Child Caretakers of Kinondoni Municipality, Tanzania. *Asian Food Science Journal*. **2**: 1- 13.
- Kaur, I. and Singh, S. 2014. Consumer Behavior of Purchase of Processed Cereal Food Products in Punjab. *IOSR Journal of Business and Management*.**16**: 47-57.
- Khadgawat, R., Marwaha, R. K., Ramot, R., Obero, A. K., Sreenivas, V., Gahlot, M., Mehan, N., Mathur, P. and Gupta, N. 2013. Impact of vitamin D fortified supplementation on Vitamin status of healthy school children aged 10-14 years. *Osteoporosis International*. **24**:2335-2343.
- Latha, M. M. 2014. Consumer awareness, perception and acceptability of fortified foods-A case study of Hyderabad metro consumers. MBA. Report submitted to Acharya N. G. Ranga Agricultural University, Hyderabad.
- Mai, A., Hop, L. T., Khan, N.C., Panagides, D., Wieringa, F., Berger, J. and Moench, F. 2012. An Assessment of the Impact of Fortification of Staples and Condiments on Micronutrient Intake in Young Vietnamese Children. *Nutrients*. **4**: 1151-1170.
- Mabaya, E., Jordaan, D., Patrick., Malope., Milly., Monkhei. and Jackson, J. 2010. Attribute preferences and willingness to pay for fortified cereal foods in Botswana. *Agrekon*. **49**: 459-483.
- Madhari, R., Nair K. M., Rachakulla, H. K., Rao, M.V, Punjal, R., Chitty, G. R. and Brahman, G. N. V. 2011. Micronised ferric pyrophosphate supplied through excluded rice kernels improve body iron stores in children: A double- blind, randomised placebo-controlled midday meal feeding trial in Indian school children. *American Journal of Clinical Nutrition*. **94**:1202-1210.
- Marliyati, S. A., Martianto, D., Andarwulan, N. and Fauzi, S. Efficacy of non branded cooking oil fortified with carotene from RPO on blood retinol and IgG of children aged 7-9 years. 2016. *Pakistan Journal of Nutrition*. **15**: 419-426.

- Martorell, R., Ascencio, M., Tacsan, L., Alfaro, T., Young, M. F., Addo, O. Y., Dary, O. and Flores-Ayala R. 2014. Effectiveness evaluation programme of Costa Rica: Impact of anaemia prevalence and haemoglobin concentrations in women and child. *American Journal of Clinical Nutrition*. **101**: 210-217.
- Motadi, S. A., Mbhatsani, V. and Shilote, K. O. Food fortification knowledge in women of child-bearing age at Nkowankowa township in Mopani District, Limpopo Province, South Africa. *African Journal of Primary Health Care and Family Medicine*. **8**: 1-5.
- Munnukka, J. 2008. Customers' Purchase Intentions as a Reflection of Price Perception. *Journal of Product and Brand Management*. **17**: 188-196.
- Murphy, S. P., Wilkens, L.R., Monroe, K. R., Steffen, A. D., Yonemori, K. M., Morimoto, Y. and Albright, C. L. 2011. Dietary supplement use within a multiethnic population as measured by a unique inventory method. *Journal of American Dietetics Association*. **111**: 1065-1072.
- Muthayya, S., Thankachan, P., Hirve, S., Amalrajan, V., Thomas, T., Lubree, H., Agarwal, D., Srinivasan, K., Hurrell, R. F., Yajnik, C. S., and Kurpad, A.V. 2012. Iron fortification of whole wheat flour reduces iron deficiency and iron deficiency anaemia and increases body iron stores in Indian school-aged children. *Journal of Nutrition*. **142**:1.
- Nagaraj, A., Yousuf, A. and Ganta, S. 2013. Perception of Rural and Urban Mothers about Consumption of Targeted Fortified Products in Jaipur, Rajasthan, India: A Cross-Sectional Study. *Health Promotion Perspectives*. **3**: 64-72.
- Nakkeeran, N., Chaturvedi, A., Bhagwat, S., Sankar, R. and Patel, R. 2015. Community Perception and Acceptance of Micronutrient Fortified Complementary, Food in Integrated Child Development Services (ICDS), Gujarat. *Indian Journal of Nutrition*. **2**: 107.
- National Health Family Survey (NFHS) 4. 2015-16. India Fact Sheet. Retrieved from <http://rchiips.org/NFHS/pdf/NFHS4/India.pdf> on 23/11/2018.
- National Nutrition Monitoring Bureau (NNMB). 2017. NNMB Brief Report on Urban Nutrition. Retrieved from

<http://ninindia.org/NNMB%20Urban%20Nutrition%20survey%20%20report-Final%2025-09-2017.pdf> on 05/02/2019.

- Otieno, P. K. 2013. Analysis of consumer awareness and preferences for fortified sugar in Kenya. M.Sc. thesis submitted to University of Nairobi, Kenya.
- Pastorelli, A. A., Stacchirii, P. and Olivieri, A. 2015. Daily iodine intake and the impact of salt reduction on iodine prophylaxis in the Italian population. *European Journal of Clinical Nutrition*. **69**: 211-215.
- Pinkaew, S., Wegmuller, R., Wasantwisut, E., Winichagoon, P., Richard, F., Sherry, H., Tanumihardjo, A. 2014. Triple-Fortified Rice Containing Vitamin A Reduced Marginal Vitamin A Deficiency and Increased Vitamin A Liver Stores in School-Aged Thai Children. *The Journal of Nutrition*. **144**:519–524.
- Pounis, G., Makri, S., Gougiyas, L., Makris, H., Papakonstantinou, M., Panagiotakos, D. and Kapsokafalou, M. 2011. Consumer perception and use of iron fortified foods is associated with their knowledge and understanding of nutritional issues. *Food Quality and Preference*. **22**: 683–688.
- Qiam, M., Stein, A. J. and Meenaksha, J. V. 2007. Economics of Biofortification. *Agricultural Economics*.**37**:119-133.
- Quah, S. and Tan, A. K. G. 2009. Consumer Purchase Decisions of Organic Food Products: An Ethnic Analysis. *Journal of International Consumer Marketing*. **22**:47-58.
- Quang, N. D., Turk, T., Nga, T. T. and Phuong, H. 2016. A Rapid Assessment and Response Approach for Socially Marketed Nutrition Commodities in Vietnam. *Asia Pacific Journal of Clinical Nutrition*. **26**: 182-189.
- Rani, N. and Rani, V. 2017. Dietary Diversity in Relation to Micronutrient Adequacy in the Diets of Adolescents of Fatehabad Haryana, India. *International Journal of Current Microbiology and Applied Sciences*. **6**: 302- 310.
- Romotsky, S. 2017. Americans' Awareness and Attitudes Toward Functional Foods. Retrieved from <https://apfoodonline.com/industry/functional-food-perception-vs-reality/> on 17/05/2019.
- Shalini, T., Sivaprasad, M., Balakrishna, N., Madhavi, G., Radhika, M. S., Kumar, B. N., Pullakhandam, R. and Reddy, G. B. 2018. Micronutrient intakes and status

- assessed by probability approach among the urban adult population of Hyderabad city in South India. *European journal of nutrition*. **57**: 1-13.
- Sheth, A. M., Rangoonwala, M.M., Lodhiya, K.K., Zalavadiya, D. D., Joshi, N. B. 2016. A Study On Awareness And Practice Regarding Vitamin A Intake And Its Deficiency Disorders Among Mothers Of Pre-School Children In Khirasara Village, Rajkot, Gujarat. *National Journal of Community Medicine*. **7**: 505-509.
- Singh, M. B., Fotedar, R. and Lakshminarayana, J. 2009. Micronutrient deficiency status among women of desert areas of western Rajasthan, India. *Public Health Nutrition*. **12**: 624-629.
- Susan, I., Barr., Francesco, L. and Fulgoni, V. L. 2013. Consumption of Breakfast and the Type of Breakfast Consumed Are Positively Associated with Nutrient Intakes and Adequacy of Canadian Adults. *The Journal Of Nutrition*. **143** :86-92.
- Swanepoel, E., Havemann-Nel, L., Rothman, M., Laubscher, R., Tonderayi, T. M., Smuts, C. M and Faber, M. 2018. Contribution of commercial infant products and fortified staple foods to nutrient intake at ages 6, 12, and 18 months in a cohort of children from a low socio-economic community in South Africa. *Maternal and Child Nutrition*. Retrieved from <https://doi.org/10.1111/mcn.12674> on 13/02/2019.
- Tak, J. and Wadhawan, N. 2016. Assessment of Dietary Micronutrient Deficiency Among Adolescent Girls. *Food Science Research Journal*. **7**: 340- 344.
- Thankachan, P., Rah, J. H., Thomas, T., Selvam, S. and Amalrajan, V. 2012. Multiple micronutrient fortified rice affects physical performance and Plasma vitamin B-12 and homocysteine concentrations of Indian school children. *Journal of Nutrition*. **42**: 846-852.
- Truzyan, N., Grigoryan, R., Crape, B. and Petrosyan, V. 2009. Assessment of Population Knowledge, Perception and Attitudes in Relation to Micronutrient Deficiencies and Fortified Foods. Food Fortification Report. American University of Armenia.

- Turk, T., Spohrer, R., Manus, C., Khan, V. T. and Thuy, N. T. 2016. Using Formative Research to Increase Purchase Intention of Fortified Foods to Prevent Micronutrient Deficiencies in Vietnam. *Journal of Nutrition & Food Science*. Retrieved from 10.4172/2155-9600.1000540 on 24/02/2019.
- Upadhaya, R. 2016. Food Label Reading Practices among adults of Udaipur City. M. Sc. Thesis submitted to Maharana Pratap University Agriculture and Technology. Udaipur, India.
- Vaesken, M.L., Aperte, E.A. and Moreiras, G.V. 2015. Contribution of folic acid-fortified foods to fertile women's folate Recommended Nutrient Intake through breakfast simulation models. *Public Health Nutrition*. **11**: 1960-1968.
- Van, H. C. M. and Van, I. A. 2007. Consumer perceptions of nutrition and health claims. *Appetite*. **48**: 305-324.
- Vermula, R. V. 2012. Use of food label information by urban consumers in India - A study among supermarket shoppers. *Public Health Nutrition*. **17**: 1-11.
- Verrill, L., Wood, D., Cates, S., Lando, A. and Zhang, Y. 2017. Vitamin-Fortified Snack Food May Lead Consumers to Make Poor Dietary Decisions. *Journal of the Academy of Nutrition and Dietetics*. **117**: 376-385.
- Walsh, E., Walton, J., Hayes, E., Hannon, E. M. and Flynn, J. A. 2010. Contribution of fortified foods to nutrient intakes in Irish teenagers aged 13 to 17 years. *Proceedings of the Nutrition Society. Irish Section Meeting held at Ireland during June 16–18 June*.
- Washi. 2012. Awareness of Food Labeling among Consumers in Groceries in Al-Ain, United Arab Emirates. *International Journal of Marketing Studies*. Retrieved from 4.10.5539/ijms.v4n1p38. on 01/05/2019.
- William Davidson Institute. Debunking the Myths behind Food Fortification. 2013. Retrieved from <https://nextbillion.net/debunking-the-myths-behind-food-fortification/> on 17/05/2019.
- World Food Programme (WFP). 2016. A case of fortified rice in the Gajapati District of Odisha. Retrieved from <https://www.wfp.org/sites/default/files/FINALPrintBook%20%28007%29.pdf> on 23/02/2019.

World Health Organisation. 2000. World health report. Geneva: World Health Organisation. Retrived from <https://ourworldindata.org/micronutrient-deficiency> on 22/11/18.

MAHARANA PRATAP UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
COLLEGE OF COMMUNITY AND APPLIED SCIENCES, UDAIPUR
DEPARTMENT OF FOOD SCIENCE AND NUTRITION
M.Sc. Thesis, 2019

Title: Assessment of Consumer Knowledge, Perception, Practices Towards Fortified Foods and Their Nutrient Contribution.

ABSTRACT

Across the world, more than 2 billion people suffer from vitamin and mineral deficiencies, and over 70 per cent of people in India still consume less than half of their Recommended Dietary Allowance (RDA) of micronutrients. Food fortification is one such strategy to eradicate this hidden hunger which is low-cost, convenient and effective. It is a grossly under-utilized approach in developing countries due to lack of awareness. Thus, the present study was planned with the objectives to assess consumer knowledge, perception, practices of fortified food and to calculate their micronutrient contribution in the diet of 150 female consumers of age 25 and above residing in the Udaipur city. The various aspects were assessed using a self-developed questionnaire. Micronutrient adequacy was calculated using 24-hour recall of fortified foods. Results revealed that overall knowledge regarding fortified foods was low (52%), followed by 36 per cent had average knowledge, whereas very few were knowledgable (12%). Most of the consumers were unaware of the term food fortification. There was a significant difference in knowledge score between different age groups ($p \leq 0.01$). Similarly, appreciable difference was also seen in between educational qualification of the consumer ($p \leq 0.01$). Consumers gave very neutral and mixed responses regarding various perception statements. Majority of them were skeptical that fortified foods are nutritious, or have added vitamins and minerals in them. Fortified micronutrients like, iodine, vitamin A, D were contributing more in the diet. Iodine is fortified in salt (~68%) and health drinks (~11%), Vitamin D in oil (~29.2%), milk (~11.3%), and health drinks (~8%), whereas, vitamin A in oil (~35%), milk (~17.8%), health drinks (~14.25%) and breakfast cereals (~4%) were meeting the respective RDA requirement. Ashirwad chakki atta (Unfortified), Saras, Fortune, Tata, Bournvita and Kellogg's were the most preferred brands in each of the product categories of fortified foods. Majority of the consumer agreed that its

promotion is needed as it contains added micronutrients required to prevent deficiency diseases.

Keywords: fortified foods, knowledge, perception, nutrient contribution.

Dr. Sarla Lakhawat

Major Advisor

Bhavya Pande

Research Scholar

egkj.kk çrki —f"k ,oe çkS|ksfxdh fo'ofokjy;

leqnk; ,oa O;ogkfjd foKku egkfojky;

[kk| foKku ,oa iks"k.k foHkkx

LukrdsÛkj 'kksèk dk;Z & 2019

'kh"kZd % QksVÊQkbM [kk| inkFkksZ ds çfr miHkksäkvks dk Kku] çR;{kcksèk] çFkk,a ,oa muds iks"kd ;ksxnku dk vkdyu

vuq{ksi.k

nqfu;k Hkj esa] nks vjc ls vfèkd yksx foVkfue vkSj [kfut dh deh ls ihfM+r gSa] vkSj Hkkjr esa 70 çfr'kr ls vfèkd yksx vHkh Hkh lw{e iks"kd rRoksa ds vuq'kaflr vkgkj HkÛks ¼vkj- Mh- ,½ dk vkèks ls Hkh de miHkksx dj jgs gSaA QwM QksÆVfQds'ku bl c<+rs gq, dqiks"k.k dks feVkus ds fy, ,d ,slh j.kuhfr gS tks de ykx] lqfoèkkud vkSj çHkko'kkyh gSA ;g vtkx:drk dh deh ds dkj.k fodkl'khy ns'kksa esa O;kid :i ls de mi;ksx esa vkus okyh dk;Zuhfr gSA blfy, orZeku vè;;u dk mís';] QksVÊQkbM [kk| inkFkksZ ds çfr 25 o"kZ vkSj mlls vfèkd mez dh mn;iqj 'kgj esa fLFkr 150 efgyk miHkksäkvksa dk Kku] çR;{kcksèk] çFkk,a ,oa QksVÊQkbM [kk| inkFkksZ ds iks"kd rRoksa ds ;ksxnku dk vkdyu djuk Fkka Lo&fodflr ç'ukoyh dk mi;ksx djds fofHkUu igyqvksa dk ewY;kadu fd;k x;kA lw{e iks"kd rRoksa dk vkdyu miHkksäkvksa }kjk QksVÊQkbM [kk| inkFkks± ds 24&?kaVs dk mi;ksx djds dj k x;kA ifj.kkeksa ls irk pyk fd QksVÊQkbM [kk| inkFkks± ds ckjs esa lez Kku de ¼452%½ Fkk] 36 çfr'kr dks vkSlr Kku Fkk] tcfD cgqr de miHkksäk QksVÊQkbM [kk| inkFkks± ds ckjs esa tkudkj j[krs Fks ¼412%½A QwM QksÆVfQds'ku 'kCn ds ckjs esa vfèkdka'k mÛkjnrk vufHkK FksA fofHkUu vk;q lewgksa ds chp Kku Ldksj dk egRoiw.kZ varj Fkka blh rjg mÛkjnrkvksa dh 'kSf{kD ;ksX;rk ds chp Hkh Kku Ldksj dk egRoiw.kZ varj ns[kk x;k A miHkksäkvksa us fofHkUu èkkj.kk c;kuksa ds lacaèk esa cgqr rVLFk vkSj fefJr çfrfØ;k,a nÈA muesa

Is vfèdkka'k dks lansg Fkk fd os vkgkj ikSf"Vd gSa] ;k muesa foVkfue vkSj [kfut feyk, x, gSaA vkgkjksa esa QksVÊQkbM lw{e iks"kd rRo tSls vk;ksMhu] foVkfue , vkSj Mh vfèkd ;ksxnku ns jgs FksA ued ¼~68%½ vkSj LokLF;oèkZd is; ¼~11%½ esa vk;ksMhu] rsy ¼~29-2%½] nwèk ¼~11-3%½] vkSj LokLF; is; ¼~8%½ esa QksVÊQkbM foVkfue Mh] tcf] rsy ¼~35p½] nwèk ¼~17-8%½] LokLF;oèkZd is; ¼~14-25%½ vkSj czsdQkLV lhj;Yl~ ¼~4%½ esa foVkfue ,] lacafèkr vkj- Mh- , dh vko';drk dks iwjk dj jgs FksA QksVÊQkbM [kk] inkFkks± dh mRikn Jsf.k;ksa esa ls çR;sd esa vk'khokZn ¼vuQksVÊQkbM½] ljl] Q,P;wZu] VkVk] cksuZfoVk vkSj dsy,x lcls ilanhnk czkaM FksA mÙkjnkkrkvksa esa ls vfèdkka'k us lgefR O;ä dh ¼84-66%½ fd bu mRiknksa dks çpkj dh vko';drk gS D;ksafd lw{e iks"kd rRo dh deh ls gksus okys vfèdkka'k jksxksa dks jksdus dh ;g {kerk j][krk gS A dqath 'kCn& QksVÊQkbM [kk] Kku] çR;{kcksèk] iks"kd ;ksxnku

M,- ljdk y[kkor
 çeq[k lykgdkj
 'kks|kFkÊ

Hko;k i.Ms

Appendix - I





BACKGROUND INFORMATION PROFORMA

1. Name:
2. Age:
3. Religion:
4. Caste: General/SC/ST/OBC
5. Education qualification: Secondary/ Senior secondary/Graduate/ Post graduate/Any Other
6. Occupation: Student/ Govt. employee/ Private Job/ Unemployed/ House wife/ Retired
7. Marital status of consumer: Unmarried/ Married
8. Type of family: Joint/ Nuclear
9. Family income:
10. Food habits: vegetarian/ Non-Vegetarian/ Eggetarian
11. Do you have any health related issues? Diabetes/ Obesity/ Hypertension/ Other/ No health problem
12. Do you take any food supplements? Yes/ No If yes, mention them.....

Appendix- II

KNOWLEDGE OF CONSUMER TOWARDS FORTIFIED FOODS

Scores awarded

1. What is food fortification? (1)
- i. Adding essential micronutrients in commonly consumed food products.
 - ii. Process of genetically modifying the food.
 - iii. Giving a large dose of the micronutrient as a medicinal supplement.
 - iv. Don't know
2. What are the advantages of food fortification? (Multiple options correct) (4)
- i. No change in existing food pattern.
 - ii. Improves nutritional status.
 - iii. Don't know
 - iv. Cost effective
 - v. Prevent diseases
3. Does consuming fortified foods decrease the demand of fruits and vegetables in the diet? (1)
- i. Yes
 - ii. No
 - iii. Don't know
4. The term fortified foods and organic foods can be used interchangeably? (1)
- i. Yes
 - ii. No.
 - iii. Don't know
5. Which of the following is a food fortification logo? (1)
- i. 
 - ii. 
 - iii. 
 - iv. 
 - v. Don't know
6. Does malnutrition can be prevented by food fortification? (1)
- i. Yes
 - ii. No
 - iii. Don't know

7. How does fortification affects the shelf life of food products? (1)

- i. Increases the shelf life of the product
- ii. Decreases the shelf life of the product
- iii. No effect on shelf life of the product
- iv. Don't know

8. Does daily consumption of food supplements along with fortified foods has health benefits ? (1)

- i. Yes
- ii. No
- iii. Don't know

9. In India which of following food products are generally fortified from which of the micronutrients (vitamins and minerals) ? (12)

S. No.	Food items	Micronutrients (vitamins and minerals)
i.	Salt	Iodine, iron
ii.	Wheat flour	Iron, vitamin B12, folic acid
iii.	Oil	Vitamin A and vitamin D
iv.	Rice	Iron, vitamin B12, folic acid
v.	Milk	Vitamin A and vitamin D

10. Do you know about vitamins and minerals? (1)

- i. Yes
- ii. No

If yes, mention them.....

11. What are the role of nutrients in diet? (Multiple options correct) (4)

- i.Helps to fight diseases.
- ii. Provide energy.
- iii. Promote growth and development of body.
- iv. Maintains normal functioning of body.
- v. Don't know

12. Does requirements of nutrients vary between individuals? (1)

- i. Yes ii. No iii. Don't know

13. Do you know about double fortified salt? (1)

- i. Yes ii. No iii. Don't know

If yes, what are the fortificants?.....

14. Sunlight is a best source of Vitamin D. (1)

- i. Yes ii. No

15. Which of the nutrients is good for bones and teeth development? (1)

- ii. Zinc and Vitamin A iv. Iodine and Vitamin C
iii. Calcium and Iron v. Calcium and Vitamin D
iv. Don't know

16. What are the health benefits of Vitamin A? (4)

- i. Prevents blindness.
ii. Improves immunity against diarrhoea.
iii. Prevents respiratory tract infections.
iv. Reduces the risks of certain cancers.
v. Don't know

17. What are the health benefits of antioxidants (Vitamin A, C, E, selenium, zinc etc)?

(Multiple options correct) (4)

- i. Reduces the risk of stomach diseases
ii. Reduces the risk of cataract
iii. Increases immunity
iv. Slows down the ageing
v. Don't know

18. Deficiency of Iodine in children causes? (1)

i. Impaired mental development

ii. Rickets

iii. Night blindness

iv. Anaemia

v. Don't know

19. What are the symptoms of anaemia? (4)

i. Tiredness and irritation

ii. Paleness of eyes and skin

iii. Spoon shaped nails

iv. Low concentration

v. Don't know

20. Bleeding gums and late wound healing are deficiency symptoms of which nutrient? (1)

i. Vitamin B

iii. Vitamin C

ii. Vitamin A

iv. Don't know

Appendix- III

PERCEPTION OF CONSUMERS TOWARDS FORTIFIED FOODS

S.No.	Perception Statements	Strongly agree	Agree	Neutral	Disagree	Highly disagree
A.	NUTRITION AND HEALTH					
1	Fortified foods are nutritious.					
2	Fortified foods helps to cure micronutrient deficiency.					
3	Fortified foods have added vitamins and minerals.					
4	Health conscious people buy fortified foods.					
5	Fortified product is a complete food.					
6	Fortified foods should be daily recommended.					
7	Fortified products are food supplements.					
8	Fortified foods are from animal sources.					
B.	SAFETY AND RISKS					
9	Fortified foods are not recommended to pregnant women.					
10	Fortified foods are safe for lactating women.					
11	Fortified foods are safe for infants.					
12	Fortified foods causes allergy.					
13	Fortified foods are synthetic.					

S.No.	Perception Statements	Strongly agree	Agree	Neutral	Disagree	Highly disagree
14	Excessive consumption of fortified foods have health benefits.					
C.	CONSUMPTION					
15	Fortified foods are for diseased person only.					
16	Fortified foods are for aged people only.					
17	Fortified foods are for athletes only.					
18	Fortified foods are for low class people only.					
D.	COMPARISON WITH OTHER FOODS					
19	Fortified foods are costlier.					
20	Fortified foods tastes better.					
21	There is no difference in colour.					
22	There is no difference in fortified foods and other foods.					
23	Fortified foods are more acceptable than unfortified foods.					
24	Fortified foods are easily available in local departmental stores.					
25	Fortified foods are cooked in same way as unfortified foods.					

Appendix- IV

EXISTING PRACTICES OF CONSUMER REGARDING CONSUMPTION OF FORTIFIED FOODS

1. What are the reasons of purchasing fortified food?

- i. To keep healthy lifestyle
- ii. To gain various micronutrients
- iii. Influenced by family/ friends/ media
- iv. Other (Please specify).....

2. If not what are the main reason?

- i. Not easily available
- ii. Not aware of it
- iii. Added nutrient
- iv. Not safe
- v. Any other (please specify).....

3. Do you purchase fortified foods from online grocery websites?

- i. Yes
- ii. No

4. Do you read label before purchasing any food products?

- i. Always
- ii. Occasionally
- iii. Never

4. What do you read on labels?

- i. Brand name
- ii. Ingredients
- iii. Price
- iv. Storage instruction
- v. Net quantity
- vi. Nutritional content
- vii. Manufacturing and expiry date
- viii. Fortified labels

5. Have you seen, heard or read advertisement on fortified foods?

- i. Yes
- ii. No

• If yes where did you learn about it?

- i. Advertisement on newspaper
- ii. Advertisement on magazines

iii. Promotion on health centres

iv. Advertisement on television

iv. Other (specify).....

6. Which brand do you prefer while purchasing food products?

S.No.	Brand preferences	Tick
1	Which brand of wheat flour do you consume?	
i.	Ashirwad chakki atta	
ii.	Golden harvest (fortified chakki atta)	
iii.	Patanjali wheat flour	
iv.	Laxmi blog atta	
v.	Pillsbury chakki fresh atta	
vi.	Annapurna Farm Fresh Atta	
vii.	Nature Fresh Sampoorna Chakki Atta	
viii.	Kosh oats and wheat atta	
ix.	Freshly grounded from mill	
x.	Other (specify)..... And why?.....	
2	Which brand of milk do you consume?	
i.	Amul Gold	
ii.	Amul Taaza	
iii.	Amul skimmed milk (slim 'n' trim)	
iv.	Saras	
v.	Nestle A+ nourish	
vi.	From local open market	
vii.	Other (specify)..... And why?.....	
3	Which brand of oil do you consume?And why?	

i.	Ambar groundnut refined oil	
ii.	Ankur groundnut refined oil	
iii.	Chambal refined soybean oil	
iv.	Dhara mustard oil	
v.	Engine mustard oil	
vi.	Fortune groundnut oil	
vii.	Fortune rice bran oil	
viii.	Fortune soya health	
ix.	Fortune sunflower refined oil	
x.	Fortune mustard (crude) oil	
xi.	Good life groundnut oil	
xii.	Good life refined soybean oil	
xiii.	Mahakosh soybean refined oil	
xiv.	Nature fresh Anti Heart (refined rice bran & rapeseed oil)	
xv.	Patanjali soyabean refined oil	
xvi.	Saffola gold refined blended oil	
xvii.	Saffola active (blended oil)	
xviii.	Saffola tasty (blended vegetable oil)	
xix.	Sweekar sunflower refined oil	
xx.	Other (specify)..... And why?.....	
4	Which brand of salt do you consume?	
i.	Aashirvaad salt	
ii.	Ankur salt +	
iii.	Medi +	
iv.	Patanjali iodised salt	
v.	Tata iodised salt	

vi.	Tata lit	
vii.	Other (specify)..... And why?.....	
5	Which brand of health drink do you consume?	
i.	Bournvita	
ii.	Boost	
iii.	Complain	
iv.	Horlicks	
v.	Hershey's milk booster	
vi.	Hershey's milk shake	
vii.	Patanjali Herbal Power Vita	
viii.	Other (specify)..... And why?.....	
6	Which brand of breakfast cereal do you consume ?	
i.	Indian Earth Gluten Free Corn Flakes	
ii.	Kellogg's Corn Flakes	
iv.	Kellogg's Chocos	
v.	Kellogg's Muesli Fruit & Nut	
vi.	Kellogg's Special K	
vii.	Kellogg's Special K Multigrain & Honey	
viii.	Kellogg's All Bran Wheat Flakes	
xi.	Nestlé NesPlus, Multigrain Fillows (Choco Burst)	
xiii.	Patanjali Corn Flakes Mix	
xiv.	Other (specify)..... And why?.....	

If you consume any other fortified food products please specify below.

Appendix- V

List of Supermarkets in Udaipur city

1. Cooperative Super market- Shastri circle
1. Cooperative Super market- Panchvati
2. Cooperative Super market- Fatehpura
3. Cooperative Super market- Sector No. 4
4. Cooperative Super market- Sector No. 8
5. Cooperative Super market- Sector No. 11
6. Cooperative Super market- Pratap Nagar
7. Cooperative Super market- Sector No. 13
8. Cooperative Super market- Ambamata
9. Cooperative Super market- Sector No. 14
10. Cooperative Super market- Hirabaag
11. Cooperative Super market- Nakoda Nagar
12. Big Bazaar- The Celebration Mall, Virtual, Phase II
13. Big Bazaar- Sukharia Circle
14. Vishal Mega Mart- Machla Magra
15. Reliance Mart- Lake City Mall, Ashok Nagar
16. Reliance Fresh- Hiram Magri
17. Reliance Fresh- Fatehpura

Appendix- VI

EVALUATION SHEET

Folder on Importance of Fortified Foods.

Name of the panel member:

Designation:

Department:

Date:

S.No.	Particulars	Scores
1.	Content	
2.	Accuracy	
3.	Language clarity	
4.	Suitability to the consumer	
5.	Layout and Design	
6.	Overall presentation	

*Scores: 5: Excellent, 4: Very good, 3: Good, 2: Fair, 1: Poor

Remarks

Signature_____

Appendix VII

Statistical values used in ANOVA

Table 1. Comparison of age groups and education qualification between knowledge of consumers using ANOVA

S. No.	Sample group	CD (1%)
1	Age group	
i.	Group 1- Group 2	3.91
ii.	Group 1- Group 3	3.85
iii.	Group 2- Group 3	4.95
2	Education qualification	
i.	Secondary- senior secondary	11.43
ii.	Secondary- graduate	7.09
iii.	Secondary- post graduate	6.78
iv.	Senior secondary- graduate	9.97
v.	Senior secondary- post graduate	9.74
vi.	Graduate- post graduate	3.83

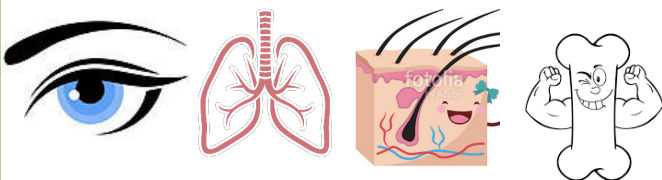
CD: Critical Difference

Oil and Milk

Nutrient fortified: Vitamin A and D

Importance of Vitamin A

- Prevents blindness.
- Keeps skin healthy.
- Slows down the ageing.
- Cancer fighting action.
- Prevents respiratory tract infections.
- Improves immunity against diarrhoea.



Importance of Vitamin D

- Promotes bone and teeth growth.
- Helps body to absorb calcium.
- Prevents rickets and softening of bones in children and in adults.
- Maintain insulin levels and helps in diabetes management.
- Boost up immune system.



Wheat flour and Rice

Nutrient fortified: Iron, Vitamin B12 & Folic Acid.

Importance of Vitamin B12 and Folic Acid

- Helps in the formation of blood.
- Helps in the formation of protein, which is needed for growth and development of body.
- Synthesis and repair of DNA and RNA.
- Helps in brain development of baby.
- Reduces the risk of infant mortality rate.
- Helps in the production of energy inside the body.



Breakfast cereals and health drinks

Breakfast cereals and health drinks are generally fortified with all the essential micronutrients namely, all the B vitamins, Vitamin A, C, D, iron, folate, calcium, zinc.

Thus, food fortification is the universal approach to fight hidden hunger.

Bhavya Pande (Research Scholar)
Major Advisor: Dr. Sarla Lakhawat
Department of Food Science and Nutrition

Fortified Foods:

Fighting for

HIDDEN HUNGER



Department of Food Science and Nutrition
College of Community and Applied Sciences
Maharana Pratap University of Agriculture and
Technology Udaipur, Rajasthan, 313001



What is hidden hunger ?

- Deficiency of micronutrients (vitamins and minerals) in body is known as hidden hunger.
- When the quality of food does not meet the nutrient requirements or when the food is deficient in micronutrients that are needed for the growth and development of the body, causes hidden hunger.



Source: UNICEF

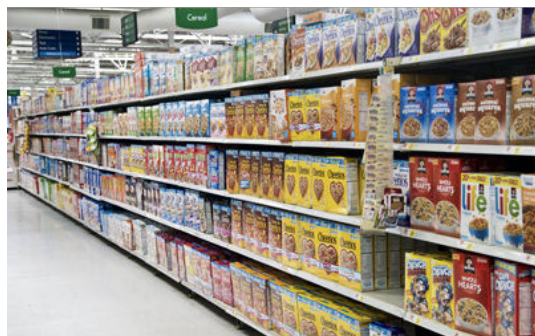
Food fortification

- It is the process of adding vitamins and minerals in minute quantities to commonly consumed food.
- It is low-cost, convenient and effective.
- Not a replacement of balanced and diversified diets to address malnutrition.
- A logo has been recently launched for various staple food products indicating the presence of various added vitamins and minerals.



Why it is important?

- Fruits and vegetables are indeed the best sources of micronutrients, but due to unawareness and modernisation, people are more inclined towards fast food and spend hours in front of computer screens which give rise to multiple micronutrient deficiencies such as rickets and soft bones in children and adults, anaemia, mental retardation.
- One-third population of the world suffers from hidden hunger, fortified products helps to correct those deficiency diseases.
- Multi-micronutrient fortified foods like wheat flour, rice, milk, oil, breakfast cereals, health drinks helps in lowering the risk.
- Micronutrients are extracted from natural sources.



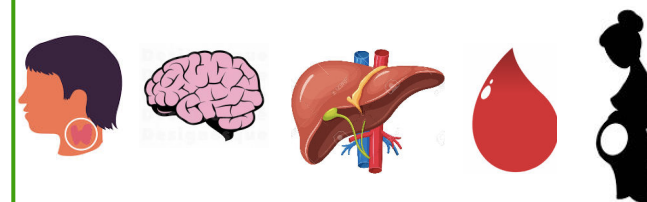
- Does not require any change in the existing food pattern of an individual.
- Bridges the gap between the need and actual consumption of required micronutrient through food.
- Fulfils 30-50 percent of daily requirements of micronutrients.

Salt

Nutrient Fortified: Iodine and iron

Importance of iodine

- Makes thyroid hormones, which prevent goitre and hypothyroidism.
- Helps in the mental development of child.
- Strengthen the bones and teeth



Importance of Iron

- Helps in the formation of blood (haemoglobin).
- Helps in the transportation of oxygen.
- Helps in the absorption of Vitamin A.
- Helps in the synthesis of protein.
- Detoxifies the harmful and toxic compounds from the liver and intestine.

