DEVELOPMENT OF PIZZA BASE USING FUNCTIONAL INGREDIENTS

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ABSTRACT

Background: *Iron deficiency anaemia is a global problem affecting a remarkably high percentage of people in India. It results in motor and mental impairment in children and poor work productivity and reproductive performance in adults. Current eating trends indicate that pizza is one most favorite snack and meal variety for today's consumer belonging to various age groups. Developing healthier variety with utilization of functional properties of traditional ingredients can help in its value addition.* **Objective:** *The present study was undertaken with the objective of developing alternative nutritious product for traditional pizza base.* **Methodology:** *Experimental study was conducted to develop pizza base with amaranth flour and dehydrated amaranth leaves as the main ingredients. Sensory analysis, Nutritive value and shelf life was estimated for the developed product. Label designing was done.* **Results:** *The final product was made by using amranth flour (33.82%) whole wheat flour (33.82%) and refined flour (32.35%) The mean score for overall acceptability of the developed product was 4.6 $\pm$ 0.54 for trained and 4.26 $\pm$ 0.58 for consumer panel. Nutritive profile of one serving (70 gram) of the product was energy (290.36 kcal), protein (8.55 g), carbohydrate (49.19 g), fat (6.08 g), fibre (5.91 g) and iron (5.09 mg). The product had shelf-life of a day.* **Conclusion:** *The study highlighted that the availability and use of the amaranth pizza base instead of the regular refined flour pizza base, can help in contributing to iron intake and thus can be a promising product for all age groups.*

Key Words: *Pizza base, Amaranth Flour, Whole wheat flour, Anaemia*

INTRODUCTION

"Actions speak louder than words."

Appropriate actions and execution of plans is what all the South Asian countries need to focus on, to achieve the World Health Assembly's target of achieving a 50% reduction of anaemia in women of reproductive age by 2025 relative to 2010 levels (World Health Organization, 2014; Harding et al, 2018). Anaemia is the clinical condition characterised by reduction in haemoglobin concentration of blood below the normal for the age, sex, physiological condition and altitude above sea level of that person (Viteri, 1998). Although, anaemia is a global problem, the largest burden of anaemia is on India (Nguyen et al, 2018). It involves population of all age groups and sex (Bamji et al, 2003). A remarkably high percentage of people are affected in India from various demographic groups, including children between the age 6-59 months (58%), adolescent girls between the age 15-19 years (54%), adolescent boys between the age 15-19 years (29%), women of reproductive age (53%), pregnant women (50%) and lactating women (58%) from all the districts of India (https://anemiamuktbharat.info, 2019).

Anaemia is responsible for impaired scholastic performance in school children and poor reproductive performance in young women. It is also directly and indirectly responsible for 10-20% of maternal deaths, high incidence of premature births and intrauterine malnutrition (Bamji et al, 2003). The intangible cost of anaemia- encompassing a range of sequelae such as motor and mental impairment in children and lower work productivity in adults- has been estimated at 1.3% of gross domestic product for children and 4% of gross domestic product for children and adults combined (Plessow et al, 2015; Horton et al, 2003).

Numerous factors can be responsible for anaemia. The most common of them are the deficiency of essential elements for haemoglobin synthesis (iron, vitamin B12 and folic acid), blood loss, repeated pregnancies in females of reproductive age, worm infestation, hemolysis due to known or unknown causes and bone marrow conditions causing suppression of red cell synthesis. Chronic ailments like chronic renal failure, rheumatoid arthritis, and tuberculosis, are also known to contribute to anaemia. In elderly females, genital blood loss due to pelvic malignancies and in both sexes gastrointestinal blood loss is also an important cause of anaemia (Weissinger, 1999; Jackson, 1998; Sakiewiez et al, 1998).

The most common type of anaemia is the iron deficiency anaemia (World Health Organisation, 1998), caused majorly due to poor intake of iron in the Indian vegetarian diets. It is one of the top five leading causes of years of life lost due to disability (Harding et al, 2018). Some of the neurological and behavioural manifestations of iron deficiency anaemia include fatigueness, dullness, lack of concentration, reduced activity, poor performance, irritability, restlessness and

sometimes pica, temper tantrums and breath holding spells. Iron deficiency also leads to poor intestinal absorption especially for xylose and fat, reduced immunity, glossitis, diarrhoea and poor reproductive outcome (Bamji et al, 2003). Thus, India is paying heavily for failing to address this severe public health problem (Nguyen et al, 2018).

Taking a step to combat the problem, Anemia Mukt Bharat strategy was developed in 2018 with targets pertaining to various demographic groups (https://anemiamuktbharat.info, 2019). A set of interventions in the Anemia Mukt Bharat guidelines include Iron and Folic Acid (IFA) supplementation alongside behaviour change communication to improve pill-taking compliance, deworming, education on appropriate dietary choices and child feeding practices, promotion of delayed cord clamping, mandatory provision of fortified foods in public health programmes, and screening and treatment of non-nutritional causes of anaemia with a focus on malaria (Nguyen et al, 2018).

By 2024, India is expected to be the most populated country in the world (United Nations, 2018). Given the large number of affected individuals in the country, investments in evidence-backed actions to reduce anaemia are important for Indians and are critical to achieve global anaemia reduction targets by 2025 (Nguyen et al, 2018).

Notably, the various ways available for preventing and treating anaemia can have side effects; like over dosage of oral iron may lead to nausea, vomiting, pain in abdomen, constipation or diarrhoea; parenteral iron therapy may lead to immediate anaphylactoid reactions, painful and discoloured injection sites, deposition of significant amount of iron at the injection site and delayed and prolonged systemic reactions such as fever, muscle and joint pains etc.; blood transfusion may lead to adverse reactions and is only chosen in extreme cases (Bamji et al, 2003).

Thereby, dietary approach, being the safest to combat iron deficiency anaemia, should be focused on and thus, iron rich foods should be encouraged in the diets (Bamji et al, 2003) to provide the recommended dietary allowances (RDA) of iron of 5 mg for weaning infants, 9-27 mg for children, 28-32 mg for adolescent boys, 26-27 mg for adolescent girls, 17 mg for adult men, 21 mg for non-pregnant or lactating women and 35 mg for pregnant women per day (Indian Council of Medical Research, 2010).

Promotion of consumption of pulses, green leafy vegetables, other vegetables (which are rich in iron and folic acid) and meat products rich in iron and superior bioavailability of iron particularly by pregnant and lactating mothers and preschool children and in weaning foods of infants; along with regular consumption of foods rich in vitamin C to promote iron absorption such as orange, guava, amla etc. is of utmost importance for combating anaemia (Bamji et al, 2003).

Amongst the cereals and millets, amaranth seeds *(Amaranthus cruentus)* are the richest source of iron, with 100 grams of pale brown variety providing 8.02 mg of iron (Longvah et al, 2017). The amaranth which is commonly known as rajgira (king seed), ramdana (seed sent by God) is a pseudocereal and not a true cereal (Bhat et al, 2015), meaning it is a dicot instead of a monocot. (Ceglinska et al, 1999). Amaranth is a good source of riboflavin (Berghofer et al, 2002) and also minerals such as iron, calcium, magnesium, potassium, phosphorus and sodium (Shukla et al, 2006; Gajewska et al, 2002). It is also known for its good quality proteins rich in essential amino acids such as lysine, tryptophan and sulphur containing amino acids like methionine (Bressani, 1989). Besides, amaranth seeds and their products are a rich source of bioactive substances showing antioxidant properties (Worobiej et al, 2009; Klimczak et al, 2002). Research findings by Raj in 2018 also concluded that the combined use of wheat flour and amaranth flour, Red rice flour and amaranth flour in developing instant mix such as Puttu/kozhukattai, Adai and Idiyappam at different levels resulted with greater protein, energy, fat, fiber, iron and calcium content than simply prepared ready mix with wheat and red rice flour. In 2013, Sanz-Penella et al. found the replacement of wheat flour by whole Amaranthus cruentus flour (up to 40 g/100 g) in bread, significantly increased protein, lipid, ash, dietary fibre and mineral contents with a significant slight depreciation in bread quality. Thus, the inclusion of amaranth flour could be limited to a maximum proportion of 20 g/100 g, thereby maintaining both product quality as well as the nutritional benefit of this ingredient. In 2014, Muyonga concluded that heat treatment enhances antioxidant activity of grain amaranth and causes rheological changes dependent on the nature of heat treatment.

Amaranth leaves, green *(Amaranthus gangeticus/ Amaranthus viridis/ Amaranthus tricolor)* are also a good source of iron, with 100 grams of fresh leaves providing 4.64 mg of iron (Longvah et al, 2017) and dehydrated form of that quantity providing 12.67 mg of iron (Saini et al, 2016). Dehydration is done in green leafy vegetables to preserve them, during which, water in the food is reduced to a very low level, thus achieving better microbiological preservation and retarding many undesirable reactions during storage (Ibarz et al, 2000). Amaranth leaves are known by various vernacular names like Chaulai (Hindi), Notya Shaakh (Bengali), Thandu keerai (Tamil), Thotakoora (Telugu) etc (Longvah et al, 2017). Amaranth leaves are an inexpensive and rich source of protein, carotenoid, vitamin C and dietary fiber (Prakash et al, 1991). Besides this, the plant can also grow successfully under varied soil and agro climatic conditions (Shukla et al, 2000). Saini et al. in 2016 revealed that protein , fibre and iron content increased significantly on dry heating of leaves.

Whole wheat flour, which is produced by milling the entire wheat kernel, retains the outer layers of the wheat kernel (Banu et al, 2012). It has been shown by many researchers to be a rich source of functional ingredients such as fibre, phytochemicals, essential amino acids and minerals, including iron (4.10 mg per 100 grams), that are located in the bran and fat soluble vitamins that are contained in the germ of the whole wheat grain (Dewettinck et al, 2008; Longvah et al, 2017).

Pizza base is a round, flattened disc of leavened wheat-based dough used as a base for a pizza, a savory dish of Italian origin which is topped with tomatoes, cheese, and various other ingredients (anchovies, olives, meat, etc.) and baked at a high temperature (Oxford Dictionaries, 2005). The pizza base, that is the bottom of the pizza, is also called the 'crust'. It may vary widely according to style, thin as in a typical hand-tossed Neapolitan pizza or thick as in a deep-dish Chicago-style (Braimbridge et al, 2005). It is produced similar to bread, mainly from refined wheat flour, water, yeast and salt by a series of processes involving mixing, kneading, proofing, shaping and baking (Dewettinck et al, 2008; Banu et al, 2012). It is traditionally plain, but may also be seasoned with garlic or herbs, or stuffed with cheese. The outer edge of the pizza is sometimes referred to as the 'cornicione' (Braimbridge et al, 2005). Pizza dough often contains sugar, both to help its yeast rise and enhance browning of the crust (DeAngelis, 2011).

Pizza is very popular in India and abroad, with the total pizza industry in India worth about Rs 2000 crore (Rs 20 billion) (Khan, 2018). However, refined wheat flour, which is the major ingredient of a pizza base and is used to improve the aesthetic value of the product, is derived from the processing of whole wheat grain and contains only the endosperm of the grain (Maneju et al, 2011; Catterall, 1998) . It is not a good source of iron (1.77 mg per 100 grams) and most of the other nutrients (Longvah et al, 2017). With the growing health consciousness amongst the population, their increasing demand of food products which are healthy as well as tasty and the changing lifestyle trends, the regular pizza base available in the market made of refined wheat flour, provides great opportunities for enrichment with nutrients to improve the state of public health problems in India, including iron deficiency anaemia.

Keeping the nutritional properties of amaranth flour, whole wheat flour and amaranth leaves along with the good baking qualities of refined wheat flour in mind, pizza base was formulated with amaranth flour, whole wheat flour, refined wheat flour and dehydrated amaranth leaves as the main ingredients focusing to improve the intake of iron amongst the population.

The objectives of the study were:

- To develop pizza base with functional ingredients.
- To calculate the nutritive value of the developed product.
- To conduct the sensory evaluation of the developed product.
- To determine the shelf life of the developed product.
- To design a label for the developed product.

METHODOLOGY

Experimental study was conducted to develop alternatively nutritious pizza base from amaranth flour, whole wheat flour, refined wheat flour, and dehydrated amaranth leaves and its acceptability was evaluated.

The product was developed in the Bakery Laboratory, Institute of Hotel Management, Catering and Nutrition, Pusa, New Delhi. Sensory evaluation by the trained panel was conducted in Institute of Hotel Management, Catering and Nutrition, Pusa, New Delhi and by Consumer panel in playground of Evergreen Apartments, Dwarka, New Delhi. Shelf life analysis was done in the Microbiology Laboratory, Institute of Hotel Management, Catering and Nutrition, Pusa, New Delhi.

The sample of amaranth leaves was procured from the grocery market, Dayal Bagh Colony, Faridabad and the samples of all other ingredients were procured from a kirana store, Old Faridabad. For sensory evaluation, purposive sampling was done. Panel members (n=35) were divided between two groups: Trained panel (n=5) and Untrained panel (n=30). The study was conducted from January, 2019 to April, 2019.

Tools and Techniques: Tools used for the product development were bowls, weighing scale, siever, cloth piece, baking tray, fermentation chamber and oven. For calculating the nutritive value of the developed product, Indian Food Composition Table (NIN, 2017); Nutritive Value of Indian Foods (NIN, 2010) and a study conducted by Saini et al in 2016 were used. For the sensory evaluation, 5 point hedonic scale was used. For shelf-life analysis of the developed product, instruments and materials like culture media, 10 test tubes, test tube rack, 10 petri dishes, conical flasks, measuring cylinders, Bunsen burner, pipettes, spatula, parafilm slips, marker, autoclave, laminar air flow, incubator were used.

The product was developed in six phases. First, the standard recipe was followed for acquiring the skills of making the product and scope for its modification was assessed. Then, different trials were conducted with modified ingredients on the basis of available literature and by calculating nutritive value. After the development of the final product, nutritive value (energy, protein, carbohydrate, fat, fibre, iron) was calculated. Thereafter, sensory evaluation was conducted by Trained and Consumer panel by 5 point Hedonic Rating Scale (5- Extremely like; 4- Like; 3- Neither like nor dislike; 2- Dislike; 1- Extremely dislike). Various attributes namely, appearance, taste, aroma, texture and overall acceptability were assessed in a congenial environment. Shelf-life of the developed product was estimated by the Plate Count method in which spread-way technique was used. A ten-fold serial dilution process was followed in which 1 ml of the sample is transferred to a 9 ml of the diluent to get 1:10 dilution, and shelf-life was analyzed. Finally, an appropriate label was designed with all the information assembled aesthetically.

Phase 1: Development of product with standard recipe

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Phase 2: Standardisation of modified recipe- Amaranth Pizza Base

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Phase 3: Nutritive value calculation of the developed product- Amaranth Pizza Base

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Phase 4: Sensory evaluation of the developed product

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Phase 5: Shelf-life analysis of the developed product

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Phase 6: Designing of label

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Figure 1: Phases of product development

Oven was preheated to 180°C.

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Yeast and sugar were added in a bowl of water and mixed.

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Refined flour was sieved and salt was added.

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Sugar and yeast solution was added to the flour and kneaded into a dough.

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Butter was added to the dough, which was then kept in a bowl and covered with a moist cloth.

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The bowl with the dough was kept for fermentation.

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After 20 minutes, the dough was rolled into shapes of discs and kept on a greased baking tray. Docking (piercing) was done with a fork.

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The baking tray was kept for fermentation for the second time.

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After 10 minutes, the tray was taken out and baked in the oven at 180°C for 5-7 minutes.

Figure 2: Steps for making standard product

RESULTS AND DISCUSSION

Product development: Standard pizza base was made with refined wheat flour, yeast, sugar, salt, butter, milk and water, which on nutritional analysis was found to be low in iron. Thus, modification was done to develop iron-rich Amaranth pizza base. The various trial results are presented in Table 1:

In trial A, amaranth flour (23 g), whole wheat flour (23 g), refined wheat flour (24 g) and dehydrated amaranth leaves (3 g) were used along with yeast (1.5 g), sugar (3.5), salt (2 g), butter (5 g), milk (3 ml) and water (44 ml). The developed pizza base was found to have a very chewy mouthfeel, extra salty and no flavouring. Hence, the next trial was conducted.

In trial B, modified quantities of amaranth flour (23 g), whole wheat flour (23 g), refined wheat flour (22 g), dehydrated amaranth leaves (2 g), yeast (3.5 g), sugar (3.5 g), salt (1 g), butter (5 g), milk (3 ml), water (56 ml), were used along with garlic (2 g) and dried mixed herbs- Italian seasoning (1 g). The developed pizza base had the desired mouthfeel, had some flavouring without being too salty. As it was as per the desired sensory attributes, it was considered as the final trial.

Nutritive Value: On nutritional analysis, 100 grams of standard pizza base was found to have 427.35 kcal energy, 10.48 g protein, 79.45 g carbohydrates, 6.72 g fat, 2.75 g fibre and 1.8 mg iron. Whereas, 100 grams of the final developed product was found to have 414.81 kcal energy, 12.21 g protein, 70.27 g carbohydrates, 8.68 g fat, 8.44 g fibre and 7.27 mg iron (Table 2).

Table 1: Amount of ingredients in standard products, trials and final product

Ingredients (g/ml)	Standard product	Trial A	Trial A (%)	Trial B	Trial B (%)
Amaranth flour	-	23	32.85	23	33.82
Whole wheat flour	-	23	32.85	23	33.82
Refined wheat flour	70	24	34.28	22	32.35
Amaranth leaves (dehydrated)	-	3 i.e fresh: 45		2 i.e. fresh: 30	
Baker's yeast	1.5	1.5		3.5	
Sugar	3.5	3.5		3.5	
Salt	2	2		1	
Garlic	-	-		2	
Dried mixed herbs (Italian seasoning)	-	-		1	
Butter	5	5		5	
Milk	3	3		3	
Water	35	44		56	

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Table 2: Nutritive value of the developed products

Nutrients	Standard pizza base (100 g)	Amaranth pizza base (100 g)	Amaranth pizza base (one serving: 70 g)
Energy (kcal)	427.35	414.81	290.36
Protein (g)	10.48	12.21	8.55
Carbohydrate (g)	79.45	70.27	49.19
Fat (g)	6.72	8.68	6.08
Fibre (g)	2.75	8.44	5.91
Iron (mg)	1.8	7.27	5.09

The developed product contains a fair amount of iron, much higher than the standard product (403.88%), which will help improve the iron intake of the consumers and also contains much higher amount of fibre (306.90%), which will help to prevent many lifestyle related diseases.

Sensory Evaluation: From the trained and consumer panel, the respective mean scores out of 5, for various attributes were: Appearance: 4.4 ± 0.54 and 3.96 ± 0.66; Taste: 4.2 ± 0.44 and 4.13 ± 0.81; Aroma: 4.4 ± 0.54 and 3.93 ± 0.73; Texture: 4.6 ± 0.54 and 4.13 ± 0.73; Overall acceptability: 4.6 ± 0.54 and 4.26 ± 0.58. Thus, the product was majorly liked by the trained and untrained panellists (Table 3).

Table 3: Sensory scores by trained panel and untrained panel

Sensory attributes	Trained panel MEAN ± SD	Consumer panel MEAN ± SD
Appearance	4.4 ± 0.54	3.96 ± 0.66
Taste	4.2 ± 0.44	4.13 ± 0.81
Aroma	4.4 ± 0.54	3.93 ± 0.73
Texture	4.6 ± 0.54	4.13 ± 0.73
Overall acceptability	4.6 ± 0.54	4.26 ± 0.58

Shelf life analysis: Shelf life analysis of the developed product was done for 2 days. Colonies were observed as no preservative was used in making of the product. Thereby, the developed product should not be stored for more than 1 day. Proper storage of the product in a refrigerator is expected to increase the shelf life.

Food labelling: The designed label for the developed product contains all necessary information like name of the product, list of ingredients, name and address of manufacturing unit, country of origin, net weight, date of packaging, best before date, storage instructions, maximum retail price, nutritional information, food allergens and vegetarian logo. (Figure 4)

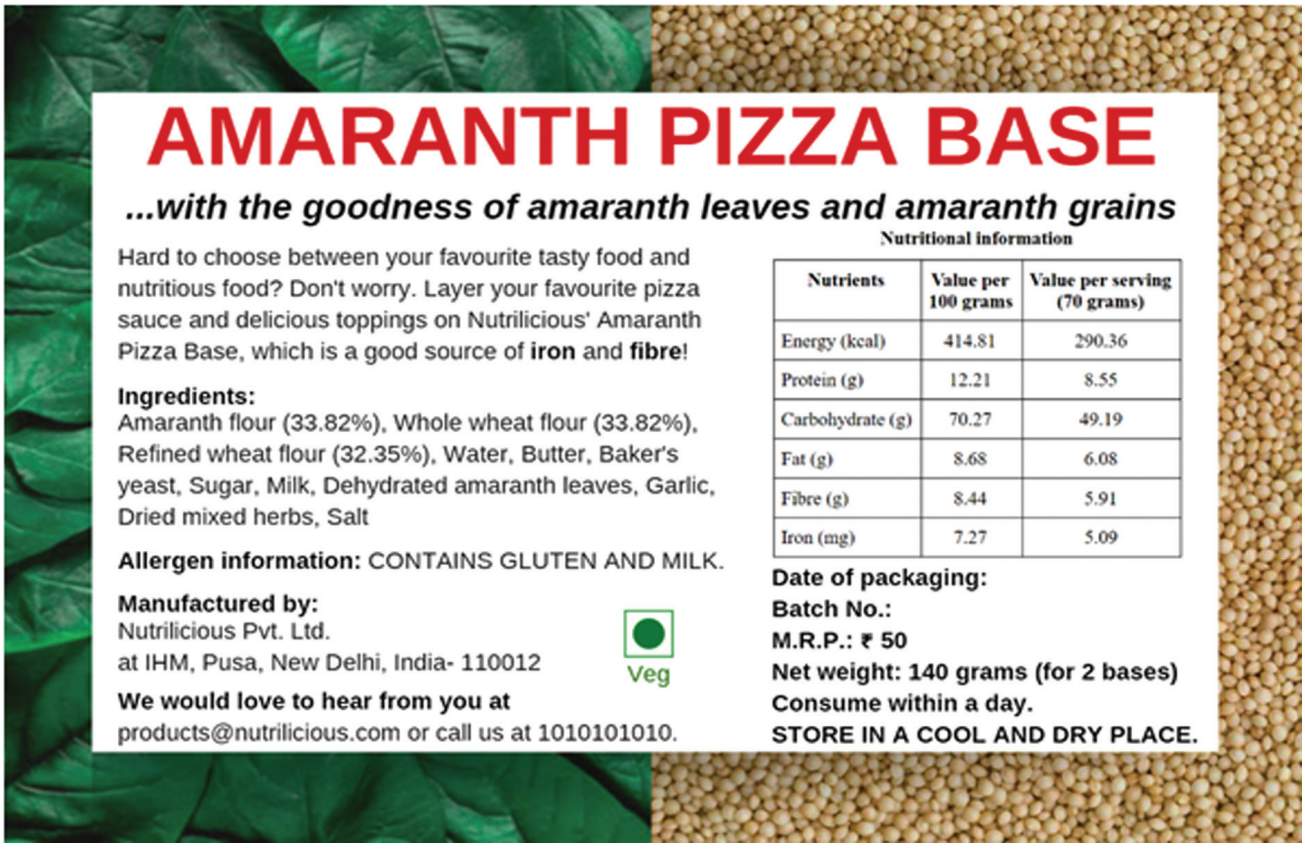

Figure 3: Food label for the final developed product

CONCLUSION

Keeping in mind the wide prevalence of iron deficiency anaemia, amongst all the demographic groups of India, its impact on productivity and the changing lifestyle trends for eating fast food, an alleged unhealthy, poorly nutritious product was made nutritious rich in iron. The product was finalised after various trials and any scope of improvement with each trial was taken care of. Nutritionally, the final product was much better than the standard product providing a much higher amount of iron and fibre. The sensory evaluation revealed acceptability from both the panels which makes it a promising product in comparison to standard product. Shelf life analysis highlighted an area of concern as the product had low shelf life. But it can be improved by storing the product appropriately in the refrigerator. A label, being a channel of communication with the consumers was designed with all the relevant information such as name of the product, list of ingredients, name and address of manufacturing unit, country of origin, net weight, date of packaging, best before date, storage instructions, maximum retail price, nutritional information, food allergens and vegetarian logo. All such information would help the product be credible in the eyes of the consumers who can be sure about the product's safety before consuming it and would also provide a means of conveying feedback or clearing queries through the information provided on the label.

Since, all the objectives of the study have been successfully fulfilled, the product can be safely consumed by the consumers and advices to intake it with adequate Vitamin C for better iron absorption can be given to improve the iron intake of the masses in India for overcoming iron deficiency anaemia, while being able to enjoy the favourite food.

CONCLUSION

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