ORIGINAL ARTICLE

Organoleptic and Cooking Quality Analysis of Pasta Fortified with Dried Leaves Powder of Amaranth and Moringa

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ABSTRACT Moringa and Amaranth leaves are considered as one of the economical natural sources of micronutrients. These are not only rich in nutrients but also contain plenty of natural antioxidants, bioactive compounds and dietary fibres. The incorporation of these nutritional sources in an optimum quantity in daily intakes can provide a better cure for various health issues like gastro-intestinal disorders, osteoporosis, obesity and diabetes etc. In the present study, an attempt has been made to initially fortify the pasta with Amaranth Leaf Powder (ALP) and Moringa Leaf Powder (MLP) followed by its organoleptic and cooking quality analysis. The control pasta was developed by using Durum Wheat Semolina: Refined Wheat Flour which is further incorporated with combination of 3, 6, 9 and 12% of ALP (A) and MLP (M). The sensory analysis of cooked pasta was carried out using 9 point hedonic scales by semi-trained panel of 10 members. The Fortified Pasta sample with highest score as compared to Control, in sensory analysis were selected for its cooking quality analysis. The preliminary observations of sensory acceptability indicated that the fortified pasta sample Control: ALP 3%: MLP 3% (C: A3: M3) scores highest among the groups. The cooking quality parameters of fortified pasta as compared to Control pasta were found in optimum cooking time (7.5 min), cooking loss (4.2%), cooked weight (221.37%), swell index (1.47) and water absorption (121.37%). Collectively, the present study suggested that the fortification of pasta with ALP: MLP (A: M) can be one of the most economical as well as potential approaches for enriching the nutritional value of pasta.

Keywords: Amaranth Leaf Powder (ALP), Functional foods, Leafy Vegetables, Moringa Leaf Powder (MLP), Pasta

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INTRODUCTION

Plants, vegetables, fruits, and legumes are natural crops and sustainable resources of bioactive components that play an important role in ensuring the global food security also. Currently, there are nearly 10000 edible plant species that exist in the globe. However, among these, only 150 species could be commercialized globally[1]. *Amaranthus* and Moringa are nutrient rich and fibre containing underutilised crops having bioactive potential.

Amaranthus commonly known as "Amaranth" belongs to *Amaranthaceae* family, is a crop with multipurpose applications which is cultivated in different types of weather and agriculture setup. Among its 70 species, only 17 are cultivated for edible leaves and 3 are cultivated as food grains. The Amaranth leaves and stems are natural & inexpensive sources of proteins (essential amino acids), dietary fibre and minerals such as Mg, P, Zn, Fe, etc. Amaranth is having ample amount of several natural antioxidant phytochemicals, such as vitamin C, flavonoids, and phenolic acids[2]. Amaranth usually cultivated and consumed in India and South-east Asian countries as grain crop or a leafy vegetable[3].

Moringa oleifera is a fast growing highly nutritious plant from a tropical and subtropical region of India. It belongs to *Moringaceae* family and commonly known as Drumstick, sahjan and munga and miracle tree etc. It is considered as an

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effective solution to combat malnutrition[4]. *Moringa oleifera* is being cultivated worldwide and gaining interest as a favourite food fortification constituent and medicinal plant because of its many nutraceutical properties viz., anti-inflammatory, antibiotic anti-diabetic, etc.[5]. Each part of the plant is edible and used in various cuisines, which provide essential nutrients for humans. In particular, *Moringa oleifera* leave contain considerable amounts of phenolic compounds, proteins, dietary fibre and minerals (calcium, potassium, iron, magnesium, etc.), while low in fat and total available carbohydrates which makes it a reason that fortification of food with *Moringa oleifera* leaves could be a healthy approach[6].

Pasta is one of the staple foods, usually made from Durum wheat semolina and widely popular because of its ease in preparation and cooking, low cost, easy transportation and handling with long storage life. The World Health Organization (WHO) and Food and Drug Administration (FDA) considered Pasta as a potential and applicable carrier for the enhancement of nutritional substances such as phenolic compounds and dietary fibre[7, 8]. Pasta products are high in starch, thiamine, iron etc. but low in proteins & dietary fibre, mainly made up of wheat flour which is deficient in lysine, an essential amino acid[8], therefore need to be enriched nutritionally. Pasta quality is influenced by various quality attributes such as physical, chemical, textural, nutritional, taste, flavour, cooking properties, etc.[9]. Because of popularity and its acceptance, the nutritional supplementation of proteins, vitamins, minerals and bioactive compounds through Pasta as carrier food could be an easy and potential approach for every age group of people. Such special characteristics and compositional makeup of Pasta have retained it in a significant position in daily diets even in higher society[9, 10, 11].

In the above context, an attempt has been made to fortify the Pasta with functional ingredients from natural resources like *Moringa oleifera* Leaf Powder (MLP) and Amaranth Leaf Powder (ALP) to overcome the nutritional deficit of Pasta particularly in terms of fibre. The incorporation of these fibre rich ingredients might be proven as positive approach towards overcoming the deficiency in Pasta without affecting much of its cooking quality and sensory parameters. Initially, the Control Pasta was developed which is further incorporated (fortification) with different proportion of ALP (A) and MLP (M) in combinations and further its organoleptic (through sensory analysis) and cooking quality characteristics studied.

MATERIALS AND METHODS

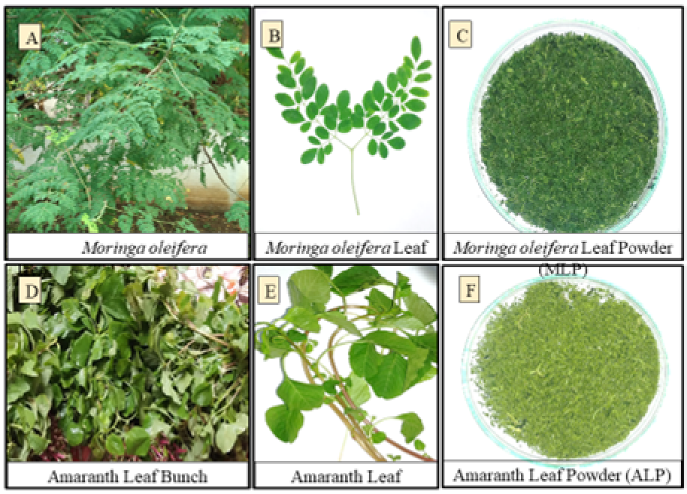
A. Raw Materials

Raw materials used in current study were Durum Wheat Semolina, Refined Wheat Flour, Amaranth Leaf Powder, and Moringa Leaf Powder. Durum wheat semolina, refined wheat flour and the fresh leaves of Amaranth were purchased from local market. Moringa leaves were collected from healthy plant/tree from local area.

B. Preparation of Amaranth Leaf Powder (ALP) and Moringa Leaf Powder (MLP)

Green, fresh and healthy leaves of Amaranth and Moringa were sorted manually and kept for further processing; broken/damaged leaves were discarded as well. Selected leaves were washed and rinsed followed by spreading on a perforated tray for 10-15 min. Subsequently, leaves were dried in a cabinet drier at 25-30 °C for 3-5 hr followed by cooling at room temperature for 30 min[12]. After drying, leaves were grinded into the fine powder and screened by stainless steel sieve (Figure 1). Immediate after the screening, the powder is quickly stored in an airtight polythene packaging bags.

Figure 1: Preparation Method of MLP and ALP



C. Experimental Design

Control Pasta (C), contains only durum wheat semolina and refined wheat flour, was developed and further fortified with varying proportion of ALP (A3, A6, A9 and A12%) and MLP (M3, M6, M9 and M12%) in combination by maintaining the weight/weight proportion of Control (C). Firstly, all the combinations of Control and Fortified Pasta, i.e., C: A: M, were subjected to the organoleptic (through sensory) acceptability analysis and, the best acceptable combination in groups was further compared and evaluated with Control for cooking quality analysis viz., cooking time, cooked weight , water absorption, swelling index and gruel loss.

D. Preparation of Standard (Control) and Fortified Pasta

The Control and fortified Pasta were made by using different proportions of durum wheat semolina, refined wheat flour, Amaranth Leaf Powder (ALP) and Moringa Leaf Powder (MLP) with the help of required amount of water. Pasta was prepared by serial steps of mixing, kneading, and extruding process in a Pasta mixer-extruder machine (Model: Dolly La Monferrina, Italy). The water was added during kneading with 31-32% of moisture content. Mixing and kneading was carried out for an optimum time of 25-30 min till it starts converting in stiff and homogeneous dough. To cut the dough, a sharp blade cutter is fixed in front of a die in extrusion machine and the speed of cutter was adjusted as per requirement so as to cut the dough in a desired shape of Pasta. Subsequently, the Control and fortified Pasta samples were dried in a cabinet drier at 55 °C for 1.3-2 hrs, followed by cooling at ambient room temperature for approx. 20-30 min. Immediate to this, the Pasta samples are packed in a commercially available zip-lock polythene pouches[13].

E. Organoleptic and Cooking Quality Analysis of Pasta

The prepared Pasta samples from all the groups were tested for quality parameters, presented and discussed in the following sections;

(i) Organoleptic/Sensory Evaluation

The analysis of sensory parameters viz., colour, flavour, texture, taste and overall acceptability of freshly cooked Pasta was carried out for organoleptic analysis using nine point hedonic scales[14] by semi-trained panel of 10 members.

(ii) Cooking Quality Analysis

Cooking quality parameters were assessed as these parameters express the quality characteristics for final acceptability of Pasta.

a. Optimum Cooking Time (OCT): The optimum cooking time (OCT) for the Control and fortified Pasta was determined by AACC method 66-50[15]. 10 gms of each Pasta samples was cooked in a 100 ml of boiling water in a glass beaker (500 ml) and observed for total time taken for complete cooking, by pressing a strand of cooked Pasta sample between two transparent glass slides. The disappearance of the white central core of the Pasta strand is considered as complete cooking and time taken is called as the optimum cooking time[16].

b. Cooked Weight: For cooked weight analysis of pasta **s**amples, a 10 gms of pasta samples were placed in a 100 ml of boiling distilled water in a glass beaker (500 ml). The cooked weight of Pasta (%) samples was calculated using following equations as per AOAC method[17].

Cooked weight = [weight of cooked Pasta (g)/weight of uncooked Pasta (g)] × 100

c. Water Absorption: The % water absorption in completely cooked pasta samples was measured by using the following well established equation[16].

Water absorption = [(Weight of cooked Pasta - Weight of raw Pasta)/Weight of raw Pasta] × 100

d. Swelling Index (SI): Swelling index of cooked pasta was measured by using the method described by Tudorica[9]. Swelling index of cooked Pasta (SI; ml of water per gram of dry Pasta) was evaluated by drying the Pasta samples to a constant weight at 105 °C in a Hot air oven. The swell index is expressed as follows:

Swelling index = [Weight of cooked product (W1) - Weight after drying (W2)]/Weight after drying (W2)

e. Cooking/Gruel Loss (CL): Cooking/Gruel loss of each sample was determined by evaporating cooking water to a constant weight in a hot air oven at around 103 °C. The dried residue was weighed and the cooking loss was calculated according to the following expression[16].

Cooking Loss = [Weight of cooking water dried residue/ Weight of raw Pasta] × 100

f. Statistical Analysis: Statistical analysis of data was carried out in each experiment, which was performed with at least three independent observations. Student *t*-test was performed where ever applicable. Error bar are presented as standard error of mean.

RESULTS

The present study was envisaged to evaluate the effect of fortification of pasta with Amaranth leaf powder (ALP) and *Moringa oleifera* leaf powder (MLP) on the cooking and sensory characteristics. The Control Pasta (C) was prepared by using durum wheat semolina with refined wheat flour was fortified (Figure 2). The results of sensory evaluation of Control and Fortified Pasta samples shows that fortified pasta sample

Figure 2: Preparation Pasta (Control and Fortified)

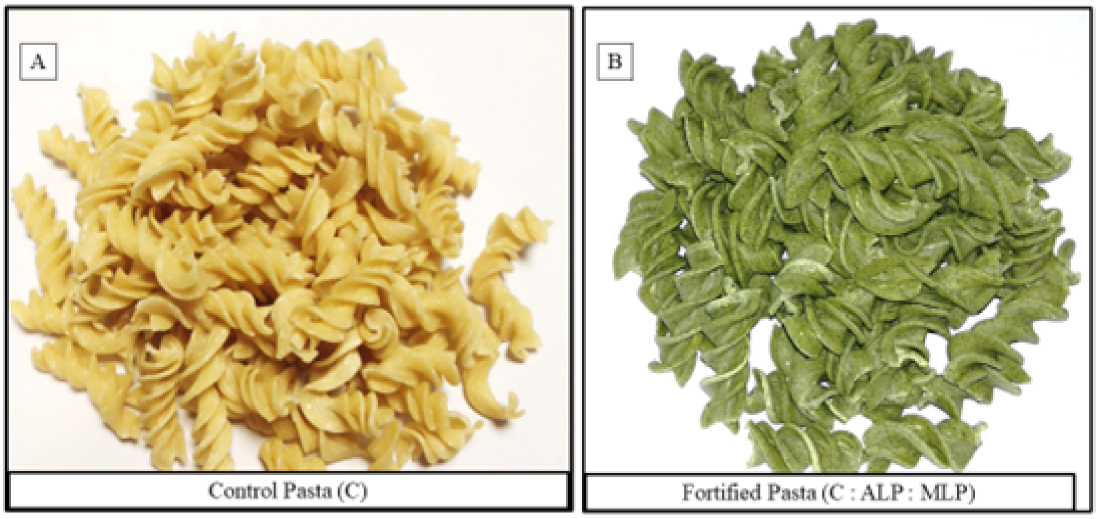
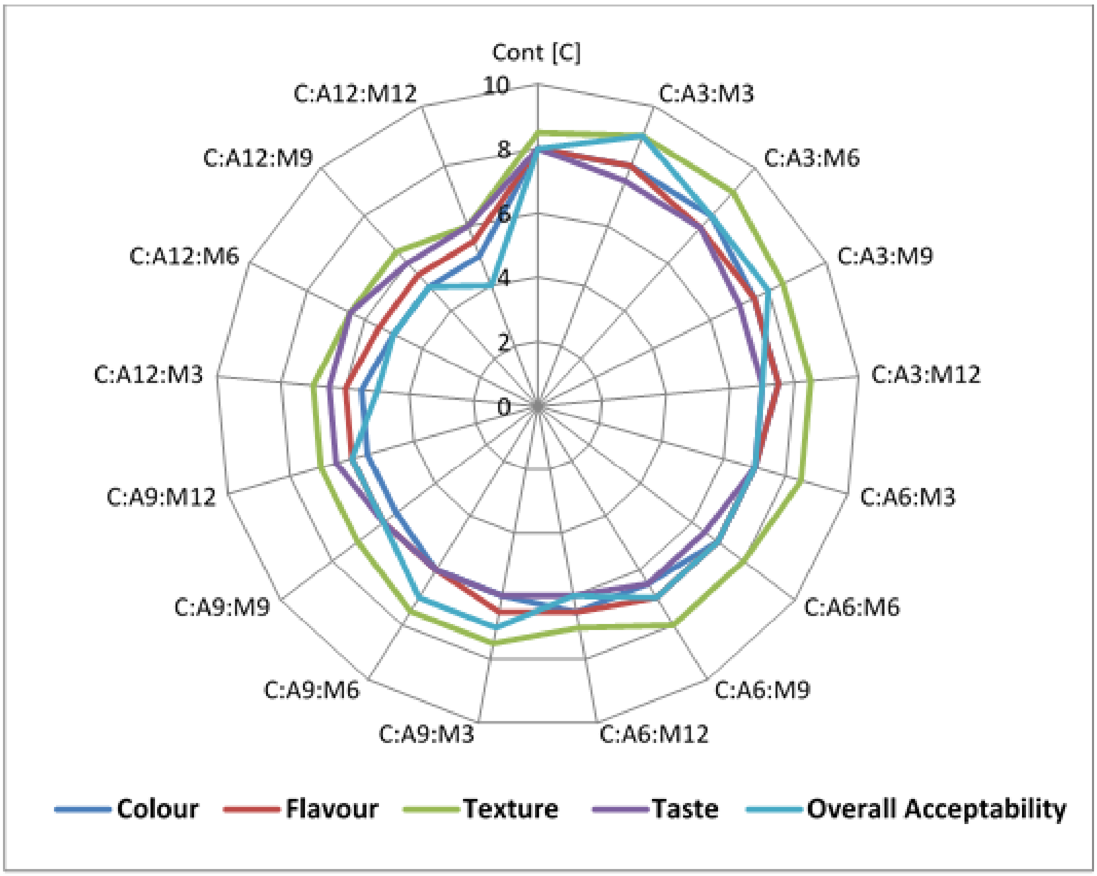
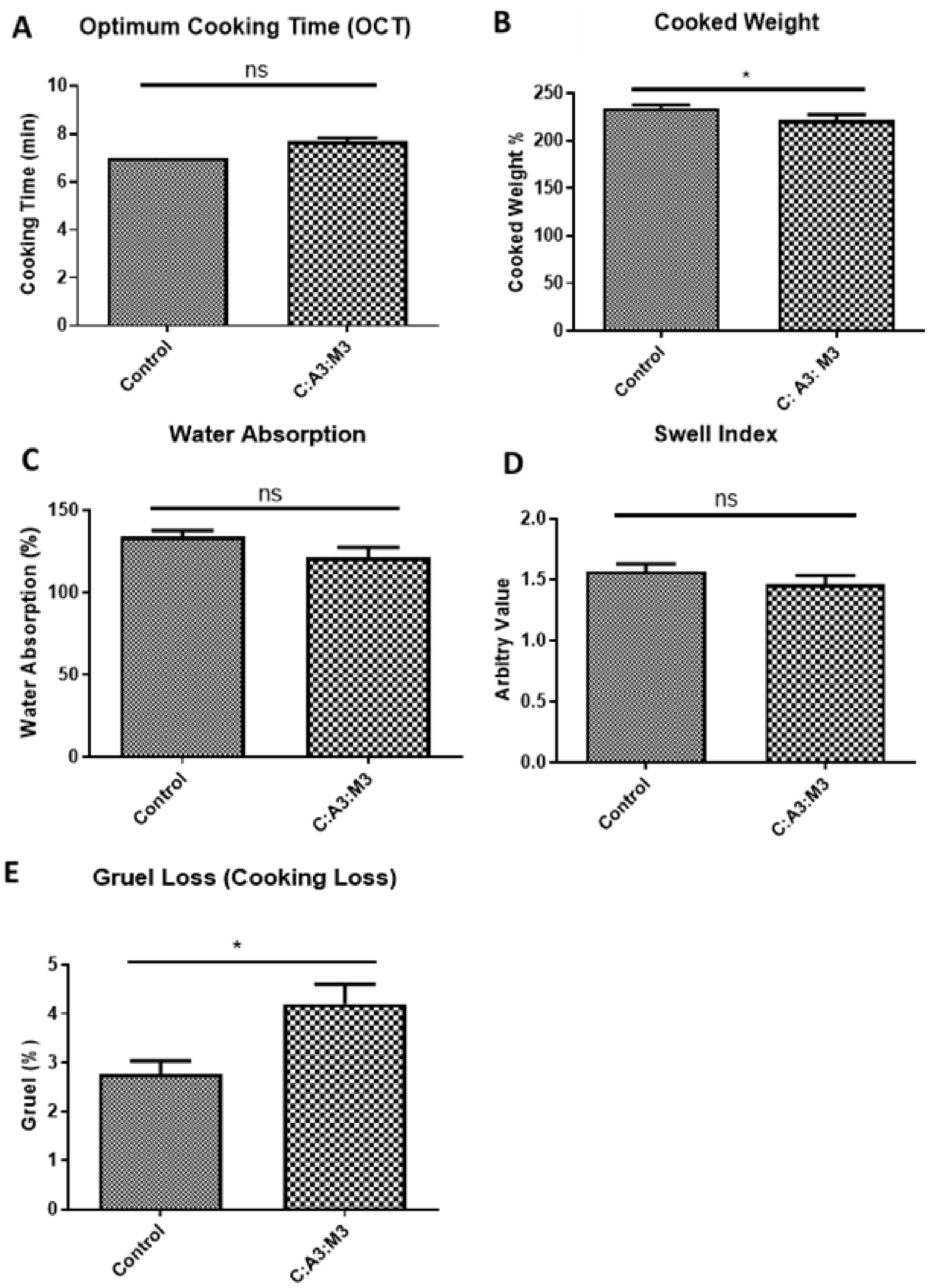


Figure 3: Sensory Analysis of Control and Pasta Fortified with ALP and MLP



Control: ALP 3%: MLP 3% (C: A3: M3) scores highest 9 point among the groups whereas, the Control pasta scores 8 (Figure 3). In the light of comparison between Control Pasta and Fortified Pasta in respect of cooking quality analysis are shown in Figure 4. The Fortified Pasta (C: A3: M3) took relatively more cooking time (7.5 min) as compared to Control Pasta (7 min). The cooked weight was recorded high, i.e., 234.37% in Control as compared with fortified Pasta (221.37%). The swell index and water absorption was found higher (1.57 and 134.37%) in Control Pasta than fortified Pasta (1.47 and 121.37%). The cooking loss in fortified Pasta (4.2%) was relatively more than the Control Pasta (2.77%).

Figure 4: Cooking Quality Parameters-Values are Mean(±1 SD) of Three Observations from Independent Experments



Note: Significance of difference is calculated among control vs. Treatments group (ns = non-significant, *p<0.05, **p<0.01, ***p<0.001). (A) Optimum Cooking Time; (B) Cooked Weight; (C) Water Absorption; (D) Swell Index; (E)Gruel Loss/ Cooking Loss.

The present study suggested that the fortification of Control Pasta (C) with ALP: MLP (A: M) can be chosen as one of the noteworthy approach for enriching the Pasta as nutritional ingredients. Still, there is lot of scope in optimization of the fortification and cooking process to minimize the cooking loss while retaining the nutritional value as well.

DISCUSSION

Sensory analysis and cooking quality, i.e., optimum cooking time, swelling or water absorption during cooking flavour, and taste, texture of the cooked product, gumminess are one of the most important parameters for consumers to determine the quality of Pasta which helps in increasing its popularity and commercialisation. Sensory analysis collectively indicated that the fortified Pasta sample i.e. C: A3: M3 was found most acceptable combination. Cooking time of Pasta plays a very significant role in its consumer acceptance as well as in retaining the nutritional properties of raw Pasta. In this study, the cooking time was increased in fortified Pasta as compared to Control Pasta, and it may be due to incorporation of leaves (fibre). Previous studies reported that the lower amount of fibre enrichment is also linked with its no effect on the optimal cooking time[18, 19], relatively lesser quantity available in cooking mix which is not sufficient enough to facilitate or affect the cooking process, and therefore the optimum cooking time[20], rather in such cases cooking time has been shown to increase the optimal cooking time[21, 22].

The relative differences in time taken for complete cooking of the Pasta among these groups indicated that the blending of durum wheat semolina and refined wheat flour (*i.e.* Control) with ALP and MLP might have influenced the interaction between the gradients which might result in alterations in other cooking properties. Cooked weight, swelling capacity, water absorption and the cooking loss significantly influence the net weight of cooked Pasta, and also these parameters are largely dependent on the nature and the type of ingredients present in the Pasta blend flour. The cooked weight of Control Pasta was higher than the fortified Pasta, the relative differences in cooked weight have largely been shown to depend on the composition of the raw flour and Pasta blend materials used, may possibly affecting the cooking weight.

The swelling properties of raw Pasta flour and the process of making of Pasta blend may significantly influence the water absorption. The Pasta enrichment with dietary fibre content/ supplements has been shown to affect the water absorption properties of Pasta blend as compared to raw Pasta[21]. In present study, the water absorption was relatively higher in Control Pasta as compared to fortified Pasta.

Swelling index of a food material is an important indicator of amount of water absorbed during its preparation and cooking process by the starch and protein present in the composite raw flour material. The absorbed water is used for the starch gelatinization and protein hydration process. A food sample with the minimum swelling index is expected to have more nutrient density[23]. Indeed in previous studied, there are mixed findings on the effect of fibre content on the swelling index of Pasta, as some of them suggest that the increase in fibre content, decreases the swelling index of Pasta [24]. In view of the above, the swelling index of the fortified Pasta was decreased as compared to Control Pasta and has been further attributed to the binding of the starch granules, strength and characteristics.

The solids gruel which is leached out in the cooking water during its cooking process is considered as the gruel loss and is also termed as the cooking loss. Gruel loss is one of the prominent factors in determining the cooking quality and, also its overall consumer acceptance. Indirectly, the loss of gruel in the cooking water is used as an indicator of nutritional as well as cooking quality of Pasta[25]. The gruel loss was found to be relatively lower in case of Control Pasta while it was more in fortified Pasta. The observed differences in gruel loss may possibly be due to the nature of ingredients, solubility in water, interferences in gelatinization and the cooking time. This outcomes is partially supported by reported studied that gluten network provides amylose retention capacity during cooking process and the weakening of gluten network due to protein and fibre supplements may cause to increase the cooking loss.

CONCLUSION

The results of the study shows that the fortification affected the cooking and sensory properties of pasta. The incorporation of ALP and MLP in pasta may enhanced the nutrients content of the cooked pasta which can be reduce some major health issues. These unique formulations/ valuable underutilised ingredients, i.e., amaranth and moringa, in pasta had good sensory acceptability by consumers with non-significant changes in cooking quality parameters. However, there is lot of scope in optimization of fortification process to minimize the cooking loss while preserving the nutritional value as well.

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