



## Fortification Of Composite Product (with solids) Pasta With Health Promoting Phytochemicals

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### ABSTRACT

India is one of the major producers of millet crop in the world. Millets are a major good sources of energy. They provide protein, fatty acids, minerals, vitamins, dietary fibre and polyphenols. Typical millet protein contains high quantity of essential amino acids especially this sulphur containing amino acids.

This study focused on the use of sprouted millet flour and nuts mixed with the green leaves juice to add colour and nutritional value to textured products like pasta. Three different variations were developed by the replacement using of red amaranth leave juice and curry leaves juices in the proportion of T1,T2,T3 list samples (T1=85gm WF + 5gm FM + 5gm RJ+ 5gm Peanut, T2=70gm WF + 10gm FM + 10gm RJ + 10gm Peanut, T3=55gm WF + 15gm RJ + 15 FM + 15gm Peanut) Further the curry leave juice in the proportion of T1,T2,T3 variations (T1 85 gm WF + 5 gm Bajra + 5 gm CLJ + 5 gm Pistha, T2 = 70 gm WF + 10 gm Bajra + 10 gm CLJ + 10 gm Pistha, T3 = 55 gm WF + 15 gm Bajra + 15 gm CLJ + 15 gm Pistha.

Physical properties like swelling index, water absorption, cooking time, and cooking weight evaluated were done, and Nutritional properties like moisture, protein, and fibre were analysed. The organoleptic qualities of the extruded samples were analysed by semi trained panel members on a structured 5 point hedonic scale. The findings of the present study revealed significant differences ( $P < 0.05$ ) in all the parameters. The result obtained indicate higher beneficial effects preference for in the variation T3 for Red amaranth leave juice and T2 for Mint Leave juice and T3 Curry leave juice. This pasta can act as a natural colourants and have the health promoting phytochemicals.

**Key words:** Vegetable pasta, phytochemicals, wheat flour (WF), Finger millet (FM), Red amaranth leave juice (RJ), Foxtail millet (FM), Curry Leave Juice (CLJ).

## INTRODUCTION :

Increased demand by growing number of health conscious consumers for healthy foods has shifted the interest of researchers and food manufacturers to develop pasta products rich in minerals, vitamins, fiber, and with low glycemic index. Bustos et al (2) have reported that among the functional foods, pasta is an ideal vehicle for the well being advancement depending on its low cost, long shelf life and high worldwide consumption. The World Health Organization (WHO) and Food and Drug Administration (FDA) consider pasta as an appropriate vehicle for the incorporation of nutrition supplements(3).

In the recent past, the food industry has made endless effort to introduce newer functional pasta products enriched with nutrients and bioactive compounds(4) . Accordingly, different grains are utilized to substitute wheat semolina(5) . Incorporation of other grains has resulted in higher dietary benefits, like increased essential amino acids, minerals, vitamins and phenolic compounds. In addition, for unique sustenance composite flours are wont to develop gluten-free or low glycemic index pasta. A few researches have examined the potential use of functional ingredients to produce pasta which are enriched with dietary fiber (6), bran(7) , legume flour(8) , whey and egg white powder(9) , millet and other plant materials(2,10).

Pasta may be a staple food in many countries everywhere the planet . Though pasta is straightforward and straightforward to supply , the value of main ingredient durum semolina is critical in popularizing pasta. Many research studies are conducted round the world to develop pasta products with nonconventional ingredients and added functional properties to satisfy the demand of health conscious consumers.

The compositions of raw materials which are used for the pasta preparation directly affect the physical, chemical and textural properties. Therefore, incorporation of nonconventional ingredients resulting in contradictory effect of pasta quality and incorporation of nonconventional ingredients without affecting the standard attributes of pasta is somewhat difficult. Thus, more attention is required to innovate novel nonconventional ingredients to enhance the standard of the dough and to develop nutritious pasta products with better quality attributes.

In this way, the aim of the research is required to acknowledge and develop nonconventional ingredients with better usefulness and sensible expenses to supply novel pasta products.

The current study was carried out to explore the possible functionality of fortification of pasta with varying concentrations of Red amaranth Juice (RJ) and Curry Leave Juice (CLJ) followed by evaluation of the cooking quality (including the cooking time, cooking weight, cooking loss/gruel loss and water absorption) and sensory attributes evaluation (taste, texture, flavour, colour and overall acceptability on the basis of 5-point hedonic scale).

### OBJECTIVES :(last paragraph of introduction)

- The present investigation was undertaken with the following objectives.
- To study the effect of processing treatments on physio-chemical and functional properties of the selected millets.
- To develop process technology for innovative value added products from selected millets.
- To study the quality parameters(morphological, physicochemical, sensory properties) shelf stability and economic feasibility of developed millet products
- To evaluate bioavailability of micronutrients in developed millet products by in-vitro methods

## 2.MATERIALS AND METHODS:

**2.1 Selection and procurement of raw materials:** Raw materials used in current study were, the refined wheat flour, semolina and Red amaranth Juice (RJ) and Curry Leave Juice (CLJ).

**2.2 Preparation of Red amaranth Juice (RJ):** To prepare the Red amaranth juice (RJ), initially, the fresh Red amaranth leaves were manually selected and collected carefully, while damaged one were discarded as well. Leaves were washed gently in tap water for the removal of all kind of dirt and dust. Fresh Leaves are ground by drinking water and filtered by filter to extract the juice and it was immediately mixed with flour to make pasta dough.

**2.3 Preparation of Curry Leave Juice (CLJ):** To prepare the Curry Leave Juice (CLJ), initially, the fresh Curry Leaves were manually selected and collected carefully, while damaged one were discarded as well. Leaves were washed gently in tap water for the removal of all kind of dirt and dust. Fresh Leaves are ground by drinking water and filtered by filter to extract the juice and it was immediately mixed with flour to make pasta dough.

**2.4 Development of standard (control) and fortified pasta blends with Red amaranth Juice (RJ) and Curry Leave Juice (CLJ) :** The control and fortified pasta samples were dried in a cabinet drier for 1.15 - 1.30 hr at around 55°C followed by cooling at ambient room temperature for 10 -15 min. (Figure 1). The dried pasta samples were packed in air-tight polythene bags and stored in a cool and dry place for further analysis.

**2.5. Cooking quality analysis:** Cooking quality is one of the major qualitative parameters of pasta evaluation for its acceptance. Cooking quality of control and fortified pasta was carried out by using various parameters viz., the optimum cooking time (OCT), cooked weight, cooking loss (solid gruel loss), and water absorption.. The methodology and applied mathematical formulas used in the calculation of these parameters are:

**2.6. Optimum cooking time:** The optimum cooking time for control and fortified pasta blends was determined according to the AACC method 66–50 (AACC 2008). Optimal cooking time (OCT) of pasta samples depends primarily on the rate of water penetration and starch gelatinisation (Edwards, et al., 1993).

10g each of the pasta samples was taken for cooking in 100ml of boiling water. Samples were analysed for optimum cooking time by squeezing a strands of cooked pasta samples between two transparent glass slides in a while intervals until the disappearance of the white centre core of the pasta strand occur which is considered as optimum cooking time (Delcour, et al., 2000, Edwards, et al., 1993, Tudorica, et al., 1993, Brennan, et al., 2004).

**2.7. Cooking Loss/ Solid Gruel Loss (CL/SGL):** Cooked the samples, as per standard procedure, AACC method 16-50 (AACC, 2000). In this method, the 10gm of each sample was cooked in a vessel containing 300ml of boiling water for an optimum cooking time. Subsequently, the cooking water was drained into a glass beaker and 25ml of this cooking water was taken out in pre-weighed glass petri dish followed by evaporation in hot air oven at 105°C till dryness. The Petri dish was weighed again with the dried solids. Finally, the solid loss is calculated and expressed as cooking loss (Gull, et al., 2015). In current study, the cooking loss administered by cooking the control and blends pasta samples for 10min to assess the effect of cooking time on the Cooking loss/ Solid Gruel Loss.

Cooking loss (Edwards, et al., 1993; Brennan, et al., 2004; Bui and little , 2007) was calculated by using following formula:

$$\text{Cooking Loss} = \frac{\text{Weight of cooking water dried residue}}{\text{Weight of raw pasta}} \times 100$$

**2.8. Cooking weight:** 10gm of each control and fortified pasta samples was cooked in 100ml of water for an optimum time, and cooking weight was determined by draining the cooked pasta with the help of stainless steel sieves and then weighing this drained pasta (Ronge, et al., 2017).

**2.9. Water absorption:** The water absorption was calculated by weighing the drained cooked pasta. Water absorption (Edwards, et al., 1993; Bui and Small, 2007; Fellows, et al., 1997) was calculated by using following formula:

$$\text{Water Absorption} = \frac{\text{Weight of cooked past} - \text{Weight of raw pasta}}{\text{Weight of raw pasta}} \times 100$$

**2.10. Sensory analysis:** Sensory attributes analysis was carried out to assess the effects of incorporation of RJ and CLJ in pasta by a panel of semi-trained members from the Institute of Food Technology, B.U., Jhansi. The pasta samples were cooked for the optimal cooking time for scaling these sensory attributes. This analysis was carried out by calculating 5 Point Hedonic scale Score System i.e., Colour, Texture, Taste, Flavour and Overall acceptability (OAA) (Ranganna, 1986) of the freshly cooked control and RJ and CLJ fortified pasta samples.

These samples were served in a random order to evaluate all the sensory attributes for each samples from 5-1 point scale, ranging from 'like extremely' to 'dislike extremely' respectively. This scale helps to find out the best pasta sample in between among the control and fortified RJ and CLJ pasta blends (Taneya, et al., 2014).

**2.11. Statistical Analysis:** Three independent observations of each sample for each test were taken and mean of these observations was used for statistical analysis i.e., the calculation of SD and p-value. The data obtained were subjected to analysis of variance (ANOVA) using complete randomized design.

### 3. RESULTS AND DISCUSSION

In current study, the cooking and sensory quality evaluation of pasta, fortified with varying concentrations of Red amaranth leave juice and Curry Leave Juice was attempted. The pasta samples i.e., the control and RJ and CLJ incorporated pasta blends were evaluated for cooking quality and sensory analysis on a hedonic score on 5-1 point scale. This evaluation was performed for arriving at the best combination for the fortification of pasta with Red amaranth leave juice (RJ) and Curry Leave Juice (CLJ). The results obtained from the qualitative as well as quantitative analysis of these pasta samples are presented in the following sections:

**3.1. Cooking quality:** Cooking quality is an important parameter for assessing the quality of pasta for its final acceptance. Cooking quality of pasta samples from freshly cooked control and RJ and CLJ fortified pasta blends were assessed using various parameters viz., the optimum cooking time, cooking weight, cooking loss (solid gruel loss) and water absorption. Cooking properties were assessed after completion of cooking the samples. The results from control and fortified pasta samples are presented in Table-1 and also discussed in detail in each section as follows;

**3.1.1. Optimum cooking time:** The optimal cooking time depend, on the speed of water penetration and starch gelatinisation (Edward, 1993).

To assess the optimum cooking time, the control and pasta fortified with RJ and CLJ samples were cooked completely and, the optimum cooking time (OCT) was calculated by intermittently observing the time of disappearance of the core of pasta during cooking by squeezing it between the 2 transparent glass slides. Observations indicated that the OCT ranges from 7.0 min to 9.46 min for the control pasta and fortified pasta with varying concentration of RJ and CLJ i.e. 5gm, 10gm and 15gm in T1, T2 and T3 treatment groups respectively (Table 1) however, the OCT may vary substantially, counting on the tactic of cooking adopted.

OCT was increased during a concentration dependent manner e.g. the OCT increased with the increasing concentrations of RJ and CLJ. The OCT was 7min for the control pasta and was 8, 9 and 9.46 min for RJ and CLJ fortified pasta samples (5, 10 and 15gm) respectively. It indicates that the fortified pasta samples took a touch longer time for optimum/or complete cooking as compared to the control sample. The relative difference in OCT time with the varying concentrations of RJ and CLJ are often attributed to the improved reconstitution of RJ and CLJ with pasta matrix at lower concentrations of CLJ compared to the upper concentrations.

**Table 1 :** Cooking time (in min) of Control and Pasta fortified with RJ and CLJ at various concentrations i.e. T1 (5gm), T2 (10gm), T3 (15gm). Values are Mean ( $\pm 1$  SD) of three observations from independent experiments.

|          |         | Red amaranth Leave Juice (RJ) Pasta |        |         | Curry Leave Juice (CLJ) Pasta |        |         |
|----------|---------|-------------------------------------|--------|---------|-------------------------------|--------|---------|
|          | Control | T1                                  | T2     | T3      | T1                            | T2     | T3      |
| Mean     | 7.5     | 8.2                                 | 9.4    | 9.57    | 9.4                           | 10.7   | 10.9    |
| Std. Dev | 0.30    | 0.70                                | 0.20   | 0.16    | 1.90                          | 1.75   | 1.50    |
| P-value  |         | p<0.6                               | p<0.02 | p<0.002 | p<0.10                        | p<0.05 | p<0.006 |

**3.1.2. Cooking weight:** Control and fortified pasta samples were cooked completely followed by cooked weight analysis. Cooked weight decided by taking the load of pasta drained with the assistance of chrome steel sieve. The cooking weight of control pasta and various treatments groups i.e., the T1, T2 and T3 were determined, and therefore the results obtained are presented in Figure 3. The cooking weight on top of things pasta sample was 45.5gm, where as in RJ and CLJ fortified pasta, in T1(5gm), T2(10gm) and T3 (15gm) treatment groups respectively (Table 2). These observations indicated that the load of cooked pasta was progressively increased with the increasing concentration of RJ and CLJ.

**Table 2 :** Cooking Weight of Control and Pasta fortified with RJ and CLJ at various concentration i.e. T1 (5gm), T2 (10gm), T3 (15gm). Values are Mean ( $\pm 1$  SD) of three observations from independent experiments.

|          |         | Red amaranth Leave Juice (RLJ) Pasta |         |         | Curry leaves Juice (CLJ) Pasta |         |         |
|----------|---------|--------------------------------------|---------|---------|--------------------------------|---------|---------|
|          | Control | T1                                   | T2      | T3      | T1                             | T2      | T3      |
| Mean     | 45.58   | 53.72                                | 56.72   | 59.72   | 55.84                          | 58.63   | 62.93   |
| Std. Dev | 1.076   | 1.087                                | 1.052   | 0.9470  | 2.124                          | 2.142   | 1.989   |
| P-value  |         | p<0.01                               | p<0.001 | p<0.001 | p<0.05                         | p<0.006 | p<0.005 |

**3.1.3. Water absorption:** Water absorption of cooked pasta samples were determined using well established method. The observations indicated that water absorption increased with the increasing concentration of RJ and CLJ. The water absorption ranges from 130.6% – 162.2% including control pasta samples and it had been found maximum i.e. 162.2% in pasta fortified with 15gm of RJ (T5), whereas the minimum water absorption was observed in pasta fortified with 5gm of RJ (T1) i.e. 157.7%.

The control pasta was found to possess minimum water absorption i.e. 130.6% as compared to all or any other treatment groups. The detailed results are shown in Figure 4. The relative differences in water absorption weren't significantly different among all the treatment groups which may be attributed to the water absorbing properties of RJ and CLJ probably thanks to fibre content (Foschia, 2015).

**Table 3:** Water Absorption of Control and Pasta fortified with RJ and CLJ at various concentration i.e. T1 (5gm), T2 (10gm), T3 (15gm). Values are Mean ( $\pm 1$  SD) of three observations from independent experiments.

|          |         | Red amaranth Leave Juice (RJ) Pasta |         |         | Curry Leave Juice (CLJ) Pasta |         |         |
|----------|---------|-------------------------------------|---------|---------|-------------------------------|---------|---------|
|          | Control | T1                                  | T2      | T3      | T1                            | T2      | T3      |
| Mean     | 131.3   | 158.6                               | 155.8   | 165.3   | 178.5                         | 189.3   | 179..4  |
| Std. Dev | 1.323   | 1.195                               | 1.325   | 0.9847  | 2.178                         | 2.398   | 2.054   |
| P-value  |         | p<0.001                             | p<0.001 | p<0.001 | p<0.005                       | p<0.006 | p<0.004 |

**3.1.4. Cooking Loss/ Solid Gruel Loss:** Cooking loss is one among the important parameters in assessing the cooking quality of pasta. the quantity of total content of solids which is leached call at the cooking water during cooking of the pasta is taken into account because the gruel loss. The gruel loss is additionally considered because the cooking loss (CL) therefore, the gruel within the cooking water is usually used as an indicator of pasta quality. It represents the resistance of pasta to disintegrate during the boiling, thus the low amount of solids into the cooking water indicates good cooking quality (Pagani, et al. 2007). within the current study, the gruel loss was calculated on top of things and in several combinations of pasta fortified with RJ and CLJ. The observations indicated that the cooking loss/ solid gruel loss increased with the increasing concentration of CLJ i.e. 5.0-15.0gm also like cooking time compared to regulate pasta. The gruel loss ranged from 1.25gm to 1.68gm in CLJ fortified pasta samples as compared to regulate i.e. 1.03gm with 10min cooking (Table 4). within the treatment groups, the utmost gruel loss was observed at 10min, in treatment T3 (15gm) followed by treatment T2 (10gm) and minimum solid gruel loss was observed in T1 (5gm), However, the smallest amount gruel loss was found on top of things sample. The solid gruel loss was significantly different among all the treatment groups. This cooking loss during preparation of fortified pasta with RJ and CLJ can also cause the nutrient loss which can flow from to the solubility of RJ in water, cooking temperature and time. Therefore, to stop the nutritive loss at higher treatment concentrations i.e. 15gm RJ (T3), it's much needed to optimize the cooking condition of RJ and CLJ fortified pasta and therefore the use of proper binder/ stabilizer also.

**Table 4 :** Solid Gruel Loss / Cooking Loss (in gm) of Control and Pasta fortified with RJ and CLJ at various concentration i.e. T1 (5gm), T2 (10gm), T3 (15gm). Values are Mean ( $\pm 1$  SD) of three observations from independent experiments.

|          | Control | Red amaranth Leave Juice (RJ) Pasta |        |        | Curry Leave Juice (CLJ) Pasta |        |         |
|----------|---------|-------------------------------------|--------|--------|-------------------------------|--------|---------|
|          |         | T1                                  | T2     | T3     | T1                            | T2     | T3      |
| Mean     | 1.028   | 1.283                               | 1.398  | 1.685  | 2.247                         | 2.486  | 2.987   |
| Std. Dev | 0.1259  | 0.1528                              | 0.1900 | 0.2875 | 1.2543                        | 1.3427 | 1.5674  |
| P-value  |         | p>0.05                              | p>0.05 | p<0.05 | p<0.08                        | p<0.07 | p<0.085 |

**3.2. Sensory evaluation:** Sensory evaluation of pasta is a crucial factor for its acceptability analysis on the idea of sensorial performance also as for future promotion/ commercialization. All the sensory parameters for all samples, scored positively ( $>3$ ) i.e. 7.4 to 8.57 score, revealing an honest acceptance of fortified pasta by the panellists (Table 5). it's one among the foremost important parameters for assessing the standard of pasta products which allows us to gauge the general attributes of cooked pasta. this is often also a crucial parameter for predicting the longer term commercialization of pasta products. In current study, the sensory analysis of freshly cooked fortified pasta with Red amaranth Leave Juice (RJ) and Curry Leave Juice (CLJ) was administered using 5-point hedonic scale with the assistance of a panel of the semi-trained evaluator from the Institute of Food Technology where this study was administered .

The control and fortified pasta samples with RJ and CLJ i.e. 5-15gm were evaluated for the sensory parameters like colour, flavour, texture, taste and overall acceptability (OAA). The effect of fortification of pasta with CLJ on sensory parameters is shown in Figure 6. The OAA score of pasta fortified with Curry leaves varied from 7.9 to 8.8. The hedonic scale score appears to increase in a concentration dependent manner in all the parameters except the flavour and texture. Freshly cooked pasta fortified with 15gm of moringa (T3) scored maximum in all the parameters like colour, flavour and OAA except the texture. The pasta fortified with 10 gm of RJ and CLJ found to have a relatively less score in flavour and texture as compared to T1 (5gm) and T3 (15gm) RJ and CLJ. Taken together, these observations suggest that the pasta fortification with 15gm of moringa (T3) resulted in the most acceptable combination though it has relatively lesser score in texture which can be attributed to no significant role of RJ and CLJ in enhancing the texture. The colour, texture and taste attributes were not significantly different as compared to flavour in pasta sample fortified with 15gm of RJ and CLJ (T3).

**Table 5:** Summary of cooking quality and sensory over all acceptability (OAA) of Control and Pasta fortified with RJ and CLJ at various concentration i.e T1 (5gm), T2 (10 gm), T3 (1gm), values are mean ( $\pm 1$  SD) of three observations from dependent experiments.

| Groups                         | RJ and CLJ | Summary of Cooking Quality and Sensory OAA |                    |                    |                                |             |
|--------------------------------|------------|--|--------------------|--------------------|--------------------------------|-------------|
| Red amaranth Leave Juice pasta |            | Cooking Time (min)                         | Cooking Weight     | Water Absorption   | Cooking Loss(Solid Gruel Loss) | Sensory OAA |
| Control                        | 0 gm       | 7.5 $\pm$ 0.30                             | 45.58 $\pm$ 1.076  | 131.3 $\pm$ 1.323  | 1.028 $\pm$ 0.1259             | 8.0         |
| T1                             | 5gm        | 8.2 $\pm$ 0.70                             | 53.72 $\pm$ 1.087  | 158.6 $\pm$ 1.195  | 1.283 $\pm$ 0.1528             | 7.9         |
| T2                             | 10 gm      | 9.4 $\pm$ 0.20                             | 56.72 $\pm$ 1.052  | 155.8 $\pm$ 1.325  | 1.398 $\pm$ 0.1900             | 8.9         |
| T3                             | 15 gm      | 9.57 $\pm$ 0.16                            | 59.72 $\pm$ 0.9470 | 165.3 $\pm$ 0.9847 | 1.685 $\pm$ 0.2875             | 9.3         |
| Curry Leave pasta              |            |  |                    |                    |                                |             |
| T1                             | 5gm        | 9.4 $\pm$ 1.90                             | 55.84 $\pm$ 2.124  | 178.5 $\pm$ 2.178  | 2.247 $\pm$ 1.2543             | 9.2         |
| T2                             | 10 gm      | 10.7 $\pm$ 1.75                            | 58.63 $\pm$ 2.142  | 189.3 $\pm$ 2.398  | 2.486 $\pm$ 1.3427             | 9.10        |
| T3                             | 15 gm      | 10.9 $\pm$ 1.50                            | 62.93 $\pm$ 1.989  | 179.4 $\pm$ 2.054  | 2.987 $\pm$ 1.5674             | 10.5        |

**Table 6:** Sensory Attributes analysis of Control and Pasta fortified with MLJ and CJ at various concentration i.e T1 (5gm), T2 (10 gm), T3 (15 gm). This analysis is performed on the basis of 5 point hedonic scale system.

|         | Control | T1 (5 gm) | T2 (10 gm) | T3 (15 gm) | T1 (5 gm) | T2 (10 gm) | T3 (15 gm) |
|---------|---------|-----------|------------|------------|-----------|------------|------------|
| Colour  | 3.57    | 4.57      | 4.62       | 4.8        | 4.64      | 4.65       | 4.72       |
| Flavour | 3.43    | 4.45      | 4.53       | 4.72       | 4.56      | 4.63       | 4.73       |
| Texture | 4       | 4.8       | 4.34       | 4.17       | 4.25      | 4.13       | 4.15       |
| Taste   | 3.54    | 4.32      | 4.4        | 4.32       | 4.46      | 4.5        | 4.8        |
| OAA     | 3.55    | 4.7       | 4.54       | 4.62       | 4.6       | 4.7        | 4.74       |
| t-value |         | 13.51     | 6.29       | 4.43       | 5.45      | 4.57       | 4.66       |
| p-value |         | p<0.05    | p<0.05     | p<0.05     | p<0.05    | p<0.05     | p<0.05     |

The result value of t and p in RJ and CLJ is significant at p<0.05

The current study indicates that the supplementation of red amaranth leave juice (RJ) and curry leave juice (CLJ) with Pasta can be a better choice as it significantly improved the nutritional quality especially in micro & macro nutrients. The results of cooking quality and sensory analysis indicated that pasta fortified with different concentrations of Red amaranth Leave and Curry Leave is well accepted by panelist and there cooking quality was not very much affected by incorporation of RJ and CLJ . Also, the fortified pasta products with underutilized tree Red amaranth leaves juice (RJ) and Curry Leave Juice (CLJ) is a cost effective and nutritional approach with long storage capability for enhancing the nutritional value particularly for the people who are affected by malnutrition women and children from rural area as well as some urban area of the country.

**SOURCES OF FUNCTIONAL INGREDIENTS IN PASTA PRODUCTS**

| Functional Ingredient            | Potential supplying sources   | References    |
|----------------------------------|---|---------------|
| Dietary fiber                    | Carob fiber, brewer's spent<br>Grain, legume flour, orange<br>by product fiber.   | (11-14)       |
| Natural pigments                 | Anthocyanins, betalains,<br>Carotenoids.  | (1,15)        |
| Antioxidants                     | Apple peel powder, carrot powder,<br>grape powder.  | (1,16,19)     |
| High biological<br>value protein | Egg white powder, mushroom<br>powder, fish protein powder,<br>shrimp meat powder, bean flour<br>and soy flour, fish mince, yeast<br>protein concentrate | (12,13,18-19) |

Compounding the raw materials in the combination of

Test 1: wheat flour + Sprouted pearl millet + curry leaves + pistha nuts

Variation 1: 50g+25g+20g+5g

Variation 2: 35g+30g+25g+10g

Test 2: wheat flour + sprouted finger millet+ red amaranth leaves + peanut

Variation 1: 50g+25g+20g+5g

Variation 2: 35g+30g+25g+10g

**CONCLUSION**

A brief summary on the result of "A STUDY ON DEVELOPMENT OF PASTA PRODUCTS ENRICHED WITH GREEN LEAVES, MILLTS, NUTS AND THEIR NUTRITIONAL SENSORY QUALITY ATTRIBUTES" was conventional

present along with valid conclusion drawn from the incorporation of non-conventional ingredients was highly acceptable one was 10%,15% compare to 5%.

Overall results of the study revealed that highly acceptable pasta can be prepared by addition of DSF,CP,MPP, and MLP. Incorporation of 15% DSF, 10%CP, 5%MPP, and 3%MLP was suitable for making functional pasta with acceptable quality parameters (color, cooking quality, sensory quality). Higher level of substitution of DSF (>15%),CP(>10%),MPP(>5%), And MLK(>3%) improved nutritional properties and bioactive compound present in the pasta, but it also led to deterioration in cooking and sensory qualities of pasta. Among the functional ingredients incorporated was found superior with highest overall acceptability.

Development and adoption of such functional and nutritional products in the regular diet can improve the nutritional status of the population giving protection toward degenerative diseases.

Vegetable purees, like beetroot, carrot, moringa, olifera, sprouted pulses flour and seeds were incorporated to prepare pasta and their quality attributes were studied.

It was observed that incorporation of vegetable puree moderately affected the overall quality of the developed vegetable pasta. It was observed that addition of vegetable purees improved cooking quality of all the pastas with less cooking losses. Thus, it may be concluded that the incorporation of vegetable purees affects the pasta quality attributes and it imparts attractive color to the pasta.

The quality changes in the developed pasta were supported by SEM micrographs where the interaction between starch granules and protein matrix as altered by the addition of vegetable purees. So, this study could successfully explore the addition of vegetable purees in the preparation of quick cooking, shelf stable and naturally colored pastas. More studies will be needed to improve the quality attributes of vegetable purees-based pasta.

## RECOMMENDATION

Advertise the benefits of pasta products incorporated with non-conventional ingredients through media marketing and create awareness for all the age groups to overcome deficiency diseases.

Commercial pasta was energy rich food instead of nutrient dense food like Vitamin C, Protein, Calcium, Fibre rich value added pasta products are recommended.

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