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Formulation and Quality Evaluation of Bamboo Shoot and Foxtail Millet on Nutritional, Textural and Organoleptic Characteristic of Incorporated Value Added Fettuccine

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Abstract: ***Fettuccine is one the variety of pasta. As pasta is a widely consumed food in all over the world. Efforts were initiated to prepare novel value added fettuccine pasta. For the formulation of value added fettuccine, 5 samples variation (V1-V5) were developed including standard. It was prepared from composite flour of various combination of bamboo shoot powder (BSP) (40-60g), foxtail millet flour (FMF) (90-110g), fine wheat flour (FWF) (300-400g), vegetable oil (VO) (10-15g) and to evaluate proximal, nutrient, texture and organoleptic properties of the product. The proximate analysis of fettuccine prepared with different treatments included dry carbohydrate, protein, fat, soluble and insoluble fiber according to their respective procedures. For optimum nutrient analysis of incorporated fettuccine has found to be high in carbohydrate in the V_5 (5.35%), protein in V_5 (3.51%) and fats in V_3 (0.59%). Total fiber in V_5 (1.27%). Texture analysis reported higher hardness in (V_2), stringiness in (V_1) and stickiness in (V_4). For sensory score revealed that (V_2 and V_4) had highest overall acceptability (OAA). The result was analyzed through analysis of variance technique using SPSS version 16.0 to determine the level of significance. Therefore it was concluded that bamboo shoots content low fat, high potassium content, carbohydrate, vitamins and minerals etc. Shoots have antioxidant capacity due to presence of phenolic compounds. Millets have been neglected despite their nutritive value and therapeutic use. Foxtail millet (Setaria Italica) is the second-most widely planted species of millet. It is nutritionally superior to conventional food grains and exhibits hypoglycemic effect due to presence of higher proportion of unavailable complex carbohydrate and resistant starch. So, it is very important to conserve the traditional food practices by aware the people about the importance of bamboo shoot and millets with developing value added products for the community.***

Keywords: Bamboo shoot powder, Foxtail millet flour, Fine wheat flour, Vegetable oil

1. Introduction

India is one of the rich genetic resources of bamboo with 136 indigenous exotic species under 23 genera under cultivation. Bamboo shoots are low in fat and calorie but rich in different nutrients like protein, vitamin, mineral, fiber etc (Zheng *et al*., 2014). It also contains lignin and phenolic compounds which might contribute to its anti-microbial and anti-oxidant activity (Luo *et al*., 2012).

Latest advancement proves the bamboo shoot as a functional food due to the presence of biochemical components like dietary fiber, polyphenols and sterols. A lot of evidences are found for the uses of bamboo shoots in Ayurvedic medicines. Ayurveda medicine uses the ash of bamboo shoots against different diseases in India. They are found to contain great potential as a food resource. Consumption of bamboo shoots is mainly concentrated in Southeast Asia, where they are a popular ingredient in the local cuisine. From earlier times, young edible bamboo shoots have remained one of the highly palatable dishes in China, Taiwan, Japan and Korea. (Umair Mustafa *et al.*, 2016).

Foxtail millet is non-glutinous, like buck wheat and quinoa, and is a non-acid-generating food, hence considered as easily digestible food (Prashant et al., 2005), also possesses the higher amount of proteins and minerals (Pawar & Pawar, 1997), act as a potential functional food ingredient and a supplementary protein source to most cereals, due to its high lysine content (Fatmata & Zhou, 2009).

Foxtail millet contains a pertinent amount of nutritional components, especially starch, protein, vitamins, and minerals. Foxtail millet, like most millets, is also a good source of crude fiber, helps in the digestive process and helps to induce bowl movement, thus producing a laxative effect that is beneficial fora healthy digestive system. All these nutritional properties have made foxtail millet an important ingredient for preparing noodles, nourishing gruel or soup, brewing alcoholic beverages, cereal porridges, and pancakes in China. In addition to its nutritional properties, foxtail millet has also shown to possess several health benefits like prevention of cancer, hypoglycemic, and hypolipidemic effects. (Nithya Sharma and keshavanniranjan, 2018).

In whole grain wheat flour (WGWF) all the anatomical components of the grain, such as endosperm, bran and germ are present in the same proportions that exist in the intact form. Thus, WGWF contains substantially more fibers, vitamins, minerals and phytochemicals than refined wheat flour (RF). Accordingly, it is considered as an excellent source of nutritional and functional ingredients for human health with many associated benefits, including the

reduction of diseases risk such as diabetes, cardiovascular diseases, obesity, and cancer (Liu, 2007).

However, regardless of the health benefits, WGWF can cause structural and sensory changes in food, leading to lower consumer acceptance. As a result, there are difficulties in producing WGWF food that maintains the desired functionality and quality equivalent to refined grain products. In addition to the qualitative characteristics of the final product, the use of WGWF also provides many changes in the dough properties and processing parameters. The particle size of WGWF is an important factor affecting product quality and functionality of the flour (Kihlberg *et al.,* 2004)

Noodles are one of the staple foods consumed in many Asian countries. The properties of instant noodles like taste, nutrition, convenience, safety, longer shelf life, and reasonable price have made them popular. Quality factors important for instant noodles are color, flavor, and texture, cooking quality, rehydration rates during final preparation, and the presence or absence of rancid taste after extended storage (Gulia *et al.,)*

Instant noodles are widely consumed throughout the world and it is a fast-growing sector of the noodle industry. Global consumption of the noodles second only to bread. Noodles are a staple food in many cultures made from unleavened dough which is stretched, extruded, or rolled flat and cut into one of a variety of shapes (Okoye *et al.,)*

Bamboo shoots are a rich source of nutrients and health promoting bioactive compounds such as phenols, phytosterols, and dietary fiber. A large number of studies in a variety of *in vitro* and *in vivo* system show that dietary fiber, phenols, and phytosterols have many biological effects that potentially might contribute to prevention of coronary heart diseases, cancer, diabetes and more. The present study revealed that, bamboo shoot flour had high amount of amino acid, protein, carbohydrate and starch content which holds a great promise for utilization in the development of novel bamboo shoot-based food products. The results indicate that dried bamboo shoot flour being a rich source of nutrients, could also be utilized for the preparation of noodles product products with improved nutraceutical qualities.

Shoots contain 17 amino acids (Qiu, 1992), eight of which (methionine, isoleucine, leucine, phenyalanine, lysine, tryptophan, threonine and valine) are essential for the human body. Since bamboo shoots have an average protein content of 2.65 g/100 g fresh weight, consuming shoots will supply a generous amount of protein essential for the body. Bamboo shoots are also a rich source of dietary fiber, with values ranging from 2.23 to 4.20 g/100 g fresh weight of shoot in some species. In a balanced diet, the daily recommended intake of K is 2.0 to 5.5 g/d. The K content in bamboo shoots ranges from 232 to 576 mg/100 g fresh weight (Nirmala *et al.,* 2007).

Likewise, Foxtail millet is also a good source of crude fiber, helps in the digestive process and helps to induce bowl movement, thus producing a laxative effect that is beneficial for a healthy digestive system. All these nutritional properties have made foxtail millet an important ingredient for preparing noodles product. In addition to its nutritional properties, foxtail millet has also shown to possess several health benefits like prevention of cancer, hypoglycemic, and hypolipidemic effects.

Therefore, the study was aimed to formulate a value-added fettuccine with high nutritional value. Hence the present study investigation was under taken with objectives to develop dry bamboo shoot powder and foxtail millet incorporated fettuccine and to analyze nutritional, textural and sensory evaluation of the incorporated fettuccine.

2. Materials and Method

2.1 Materials

In this investigation the species *Bambusatulda* (utang) of bamboo shoots were brought from local fields of Imphal east district. The wheat fine flour, foxtail millet fine flour and other material were procured from local market, Salem.

Processing of bamboo shoot powder and foxtail millet flour

Shoots were collected followed by peeling and chopping into small pieces with the help of knife. Pieces of shoots were boiled (3-4 hours) for the removal of glycocyanide contents at 100°C as given figure 1. The shoots were dried in sunlight for 10 days continuously and dried in hot Ezidri ultra FD 100 at 60°C for 3 hours till its weight become constant. The dried shoots were grinded for the preparation of powder. Likewise foxtail millet seeds (1kg) were stored and thoroughly washed using warm (65°C) water. It was sun dried at 45-48°C for 10 days and milled by using locally fabricated attrition mill. The powdered samples were passed through sieve (125mm) in order to obtain fine foxtail millet flour and, stored in a plastic container at room temperature as shown in figure 2.

Preparation of Bamboo shoot powder

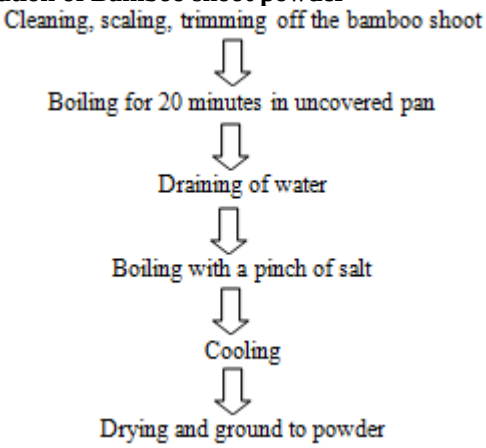

Figure 1: Traditional method of removal of HCN (*Source:* Santosh Satya *et al.*2010)

Standardization and optimization of value-added fettuccine procedure

Value-added fettuccine was prepared by mixing bamboo shoot powder with foxtail millet flour and 6 composite samples were prepared in which one treatment was control,

and 5 samples variation were mixed at different ratio as given in Table 1.

Procedure for making value-added fettuccine

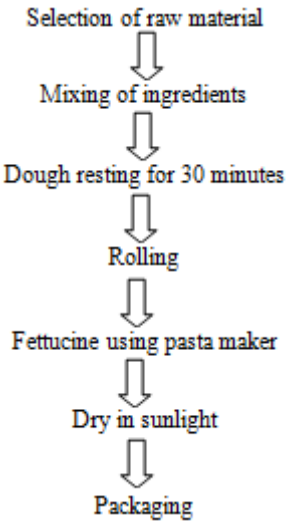

Figure 2: Formulations of value added Fettuccine

Fettuccine were prepared from the fortified flour treatments accordingly. The ingredients were added as per sequence and homogenized flours were mixed with water. The dough was kneaded for required duration and kept for 15-30 minutes. Following this, Dough was stretched and made Fettuccine using pasta maker six variation of fettuccine at different proportions as given in Table 1. Was prepare as per sequence and dried in sunlight for 2 days Fettuccine products were prepared as follows:

Table 1: Experimental model for the product

Variation	Bamboo Shoot Powder (g)	Foxtial Millet Flour (g)	Wheat Flour (g)	Vegetable Oil (ml)	Water
Standard			98	2	As require
V_1	5	15	78	2	As require
V_2	15	15	68	2	As require
V_3	5	30	63	2	As require
V_4	15	30	53	2	As require
V_5	2.92893	22.5	72.5	2	As require

Proximate analysis of value-added fettuccine

Nutrient analysis was performed for carbohydrate, protein, fat, and fiber (soluble and Insoluble) of the samples.

Carbohydrate were determined according to the method:

Amount of carbohydrate present in the 100mg of the sample= $\frac{\text{mg of glucose} \times 100}{\text{Volume of the test sample}}$

Protein was estimate according to the method:
Nitrogen content= [T. V×0.0014] where,
T. V= Titration value, 0.0014=Nitrogen content from ammonia % of protein= Nitrogen content× 6.25× 100. Soluble, insoluble and total fiber was calculated using the method:

$$\text{Crude Fiber [on dry basis]} = \frac{100[w_1 - w_2]}{w}$$

Where, W1=Weight in g of the crucible and contents before washing W2=Weight in g of the crucible containing ash.
W=Weight in g of dried material taken for the test.

Texture analysis of value-added fettuccine

The texture profile of value added fettuccine were performed using Perten Instruments TVT 6700 texture analyzer. The instrument was fitted with a 35 mm cylinder probe (P/35). Samples were tested after a period of exactly 10 min had elapsed following cooking (Bourne, 1978). Measurements were performed at room temperature (~28°C). Calibration settings used were the 5 kg load cell with a return trigger path at 15 mm. The measurement mode settings for double cycle compression (pre-test, test and post-test) were set to a speed of 1.0 mm/sec; trigger type at auto-10 g; and data rate: 200 pps, based on force-time curves of the Texture Profile Analysis and the graphs obtained were analysed for hardness, stringiness and stickiness given table 3.

Sensory evaluation of value-added fettuccines

Value-added fettuccine samples were subjected to sensory evaluation using 9-point hedonic scale (1=dislike and 9= like extremely) given table 4. Sensory attributes were evaluated by 10 panel members of six replications colour, appearance, texture, flavour, taste, and overall acceptability.

Statistical analysis of value-added fettuccine

The data thus obtained were analysed statistically for the test of significance using complete randomized design (CCRD) and randomized block design (RBD) for one-way analysis of variants. The data acquired from various experiments were recorded as mean ± standard deviation (SD). To determine the level of significance critical difference (CD) was calculated between the treatment means. The data was analysed by using SPSS version 16.0 software package and MS Excel 2010. The separation of means or significant difference contrasts was done by Duncan multiple range test. The numerical consequence was well-defined as $p \leq 0.05$.

3. Results and Discussion

Table and figure

The experiments done were consolidated and tabulated systematically, analysed statistically and the result drawn are presented and discussed appropriately under the given table. Table 2 shows the percentage of carbohydrate and protein present in value added fettuccine was found to be maximum in V_5 at the ratio (2.9: 22.5: 72.5: 2) and fat in the V_3in the ratio (5: 30: 63: 2) whereas soluble fiber and was maximum in V_5 and insoluble fiber in V_1 and V_5 and total fiber in V_5. The maximum score that can be achieved with the desirable

value of overall acceptability scores was 9 (nine). On the basis of these calculations incorporated fettuccine could be made with bamboo shoot powder: foxtail millet flour: wheat flour: vegetable oil. The effect of overall acceptability scores varied from 6 to 9 (like slightly to like extremely). Fig.2 shows that with increase bamboo shoot powder and foxtail millet there was an upsurge in sensory score of overall acceptability, same result was reported by Pragya Pandey et al. (2017) in their work optimization of value added vermicelli based on foxtail millet.

Proximate analysis of value-added fettuccine

Table 2: Proximate analysis of value-added Fettucine[1]

Sample	Fibre (g)			Carbohydrate (g)	Protein (g)	Fat (g)
	Soluble	Insoluble	Total			
Standard	0.95 ±0.02	0.12 ±0.01	1.07±0.01	4.73 ±0.01	3.53 ±0.04	0.56 ±0.02
V_1	0.84 ± 0.01	0.19 ±0.00	1.03 ±0.01	4.21±0.01	3.21 ±0.01	0.56 ±0.04
V_2	0.94 ± 0.01	0.14 ±0.01	1.09±0.01	4.55 ±0.03	3.28 ±0.01	0.53±0.01
V_3	0.99± 0.01	0.16±0.02	1.15±0.01	4.94±0.02	3.33 ±0.01	0.59±0.01
V_4	1.06 ± 0.01	0.16 ±0.02	1.21 ±0.02	5.25 ±0.06	3.38 ±0.01	0.45±0.01
V_5	1.08 ± 0.01	0.19 ±0.00	1.27 ±0.01	5.35 ±0.02	3.51 ±0.01	0.42 ±0.01

[1] Values are the mean ± Standard Deviation

Table 2 displays that total fiber content was high in V_5 (1.27± 0.01). The high fiber content might be related to the addition of bamboo shoot powder. Similar results are also reported by Om Prakash chouhan. (2016), bamboo shoots composition, nutritional value and product development for value addition.

Comparing with standard, carbohydrate (5.35 ± 0.02 g), and protein (3.51 ± 0.01 g) content were high in V_5. Whereas, fat (0.59±0.01g) content was high in V_3 In associating with standard V_3 has high fat content, it might be due to the incorporation of foxtail millet (30 g) which is high as compare to other variation. Also reported by Nirmala et al. (2017) in millet based vermicelli.

Texture analysis of value-added fettuccine

Table 3: Textural characteristics of value added Fettuccine[1]

S. No	Product	Hardness (N)	Stringiness (mm)	Stickiness (N)
1	Standard	12569.7±1401.60	9.357±0.06	-127.7±125.02
2.	V1	17819.0±4405.94	9.137±0.18	-33.7±10.15
3	V2	22372.0±1060.58	8.820±0.62	-26.7±9.61
4	V3	16168.7±1772.26	8.110±1.88	-33.0±5.00
5	V4	14938.3±3286.5	9.237±0.15	-36.3±9.24

[1]Values are the mean ± Standard Deviation (SD) of 6 determinants with a range of $p<0.05$

Measured textural parameters of value-added fettuccine samples were given in Table 5. The value of hardness ranges in V_1-V_5 was about 17819.0 to 14938.3N, stringiness 9.137 to 9.237 mm, stickiness-33.7 to-36.3N.

Hardness

Hardness is most commonly evaluated characteristics while determining fettuccine texture. V_2has (22372.0±1060.58 N) maximum hardness. It could be related to the presence of bamboo shoot and millet flour, as inclusion rate >4 used to increase hardness and chewiness, also agreed by Monisha Choudhury et al. (2015) in the study of textural properties analysis of biscuit.

Stringiness

Stringiness is the rate and extent to which a deformed material goes back to its original condition after the force has removed. Springiness was high in V_4 and V_5 (9.237±0.15mm) in both variation and low in V_3 (8.110±1.88mm). This was also might be related to incorporation of bamboo shoot and millet flour. Inclusion rate > 4 used to decrease springiness, also discussed by oinamsantosh (2018) in their study of bamboo shoot powder for food fortification.

Stickiness

Stickiness is distinct as the force necessary to overcome the attractive forces between surface of the product and the surface of the material. V_4 and V_5 (score-36.3±9.24N) has high stickiness. Whereas, V_2 (score-26.7±9.61N) has low stickiness. Comparing to standard with incorporation rate 98g of wheat flour Increased the stickiness compare to remaining 5 variation. As reported by Andrew S. Ross, (2016) in their work physical properties of cooked Asian wheat flour noodles. Pitipornritthiraungdej et al, (2011) in physical, chemical and textural properties of dried wheat noodles.

Sensory evaluation of value-added fettuccine

Table 4: Mean organoleptic scores of developed value-added Fettuccine[1]

Variations	Colour	Appearance	Texture	Flavour	Taste	Overall Acceptability
Standard	8.60 ± 0.69^{cd}	8.60 ± 0.69^{cd}	8.70 ± 0.48^{b}	7.80 ± 0.63^{a}	7.70 ± 0.67^{bc}	7.90 ± 0.31^{c}
V_1	8.40 ± 0.69^{bcd}	8.40 ± 0.69^{bcd}	8.20 ± 0.63^{ab}	8.10 ± 0.87^{a}	8.10 ± 0.87^{c}	8.50 ± 0.70^{d}
V_2	7.90 ± 1.19^{abc}	7.80 ± 1.47^{abc}	7.80 ± 0.91^{ab}	8.00 ± 0.81^{a}	8.00 ± 0.81^{bc}	8.90 ± 0.31^{d}
V_3	7.60 ± 0.51^{ab}	7.40 ± 0.51^{a}	7.70 ± 0.82^{ab}	7.70 ± 0.94^{a}	7.50 ± 0.70^{abc}	7.90 ± 0.31^{c}
V_4	7.60 ± 1.34^{ab}	7.60 ± 1.34^{ab}	7.70 ± 0.94^{ab}	7.80 ± 0.63^{a}	7.80 ± 0.63^{bc}	8.90 ± 0.31^{d}
V_5	8.10 ± 0.73^{abcd}	8.00 ± 0.66^{abcd}	7.80 ± 1.22^{ab}	7.40 ± 1.07^{a}	7.40 ± 1.07^{abc}	7.50 ± 0.70^{bc}

[1]Values are the mean ± Standard Deviation (SD) of 6 determinants. The values are determined using Duncan's Multiple Range Test ($p<0.05$).
**-Highly Significant ($P\leq 0.01$)
*-Significant ($0.01<P\leq 0.05$)

NS – Not Significant (P> 0.05)

As mentioned in Table 6, with regards to the attribute colour and appearance, all the 5 variables differs significantly with standard, it's might be due to the addition of bamboo shoot powder (5-15g BSP) and foxtail millet flour (15-30g FMF). For both colour and appearanceV_1 (score 8.40) was found to be satisfactory by the Panelist. Same result also reported by ushamalagi et al. (2017) in their work preparation of millet based. Likewise for Textural characteristics as compare standard has maximum texture properties it may be due to maximum inclusion of wheat flour (98g WF) and define significant difference between V_1toV_5 (score 8.20-7.80). In flavour and taste aspects, as compare to standard bothV_1 for flavor and taste (score 8.10) with inclusion of 5g BSP and 15g FMF was found to be accepted by penal member. Same result was reported by Sankar C. Deka et al. (2015) in their work bamboo shoot powder fortification on textural and organoleptic characteristic of biscuit.

The overall acceptability score differ significantly with standard for the fettuccine prepared with 15g BSP and 15g FMF (V_2) and 15g BSP and 30g FMF (V_4) and found to be satisfactory by the panelist. This shows that Bamboo shoot powder and foxtail millet flour incorporation improved the sensory quality of fettuccine sample up to 15-30g level, but further increase led to reduction of sensory score. These results are comparable with zubairfarooq et al. (2016) in the study preparation fortified cookies.

4. Conclusions

According to the result of the study it is concluded that influence of bamboo shoot powder and foxtail was effective in the formulation of value added Product fettuccine with the inclusion of 15-30g of bamboo shoot powder and foxtail millet flour. Incorporation rate (>5 FMF and BSP) used to improve nutritional quality especially carbohydrate, fiber and protein. Therefore, the value-added product with a ratio Bamboo shoot powder, foxtail millet flour, wheat flour, vegetable oil.15: 15: 68: 2 (V_2) and 15: 30: 53: 2 (V_4) found to be accepted by sensory panelists. Current study has suggested that inclusion of bamboo shoot powder and millet flour (>5) increased hardness and stringiness of the product. After improving the nutritional quality V5reported as good carbohydrate (5.35g), V5reported good fiber (1.27g) and V_5 protein (3.51g) and V_3fat (0.59g) content along with the overall acceptability. Therefore, with a certain outcome the attempt to formulate a value added product fettuccine has been successfully attained. Further studies are recommended on shelf life and effect of packaging on the value-added product.

Plates: Variations of developed fettuccine

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