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Optimization of Value Added Vermicelli Based on Foxtail Millet (*Setaria italica*)

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ABSTRACT

Foxtail millet (Setaria italica) is the second-most widely planted species of millet. *It is nutritionally superior to conventional food grains and exhibits hypoglycaemic effect due to presence of higher proportion of unavailable complex carbohydrate and resistant starch. Vermicelli is a popular instant food product which is tasty and easy to make, liked by people of all walks of life, irrespective of age and changing lifestyles. Hence, an attempt was made to develop foxtail millet based value added vermicelli. Standardization trials indicated that acceptable foxtail millet vermicelli could be developed by substituting 50 per cent processed foxtail millet flour in the standard vermicelli recipe. In order to improve functional properties of vermicelli further different trials were carried out by replacing wheat semolina with black gram dhal flour. Black gram dal flour was incorporated at 5, 10, 15 and 20 per cent levels by substituting wheat semolina while level of foxtail millet flour was kept constant at 50 percent. Among all the trials, vermicelli with 20 percent black gram dhal flour was found to be highly acceptable. To improve nutritional quality of developed vermicelli an attempt was made to incorporate fenugreek seed powder at level of 1, 2 and 3 percent, among which vermicelli from 1 percent fenugreek seed powder was found to be acceptable as compared to other samples. Cooking, textural and sensory properties of formulated vermicelli were observed and compared with the control. Thus, the study presented an upshot of potentials of foxtail millet as a natural designer health food for patients suffering with life style diseases.*

Key words: *vermicelli, foxtail millet, black gram dal, fenugreek seed.*

INTRODUCTION

Millets are the most drought-tolerant cereal grain crops and require little input during growth, but as with other crops, yield better with good husbandry[10]. With increasing world population and decreasing water supplies, they represent important crops for future human use. While millets are vital food crops for millions of people in parts of Africa and Asia, they are an underutilized resource in most developed countries, with being little cultivated.

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Diversification of food production must be encouraged both at national and household level with increasing yields for solving the problem of deep rooted food insecurity and malnutrition. Millets contain large quantities of phenolics and other compound which prevent deterioration of human health[14]. Supplementation of millet based snacks and food significantly improved nutritional status of school children. Technological properties of millets like flaking, extrusion, malting, baking, and parboling offer number of opportunities for processing and value addition. Ethnic foods made out of small millets have excellent taste and are acceptable both at rural and urban consumers[11,18]. Deterioration of human health can be prevented by millets as a source of neutraceuticals. Urgent attention must be given to the production and consumption of millets to ensure food and nutrition security.

Foxtail millets are widely cultivated in china, India and Africa. Western world and developed nations are slowly accepting it as food for humans as a nutritious substitute for healthier diets. In this communication an attempt has been made to find out the suitability of foxtail millet (FM) in combination with other ingredients (viz. black gram flour and fenugreek seed powder) for the vermicelli making quality.

MATERIAL AND METHODS

The present study was carried out in the Department of Food Science and Nutrition, Dharwad. Local variety of decorticated foxtail millet, black gram dhal, fenugreek seeds and commercial semolina were procured from the local market. The grains were cleaned manually and stored at ambient conditions for the further investigations.

Processing of raw ingredients

The foxtail millet flour was tried in the treatments in two forms i.e., in unprocessed flour and in processed form. Processing of foxtail millet was carried out as given in figure 1[4]. The fenugreek was processed prior to incorporation in the composite mix flour to decrease the bitterness as given in figure 2.

Formulation of composite mix flour:

Foxtail millet flour, black gram dal flour and fenugreek seed flour were mixed and passed through a 100 mesh sieve to obtain a fine powder. Various blends were prepared by incorporating foxtail millet flour, black gram dal flour and fenugreek seed powder with refined semolina at different proportions as given in Table 1.

Development of Vermicelli: Homogenized flours were mixed with water (Fig. 3). The dough was kneaded for required duration and stood for some time. Following this, dough was extruded was pre-dried at room temperature for 1 h and then dried (cabinet drier) at 600C for 4 hrs.

Observations: Each formulation was observed and evaluated for its cooking quality and pasting properties for the suitability of vermicelli development.

RESULTS AND DISCUSSION

Optimization of unprocessed foxtail millet flour for vermicelli preparation:

The foxtail millet based vermicelli was developed by optimizing the different ingredients and the process. The flour formulation and the resultant vermicelli quality are presented in Table 2. Vermicelli prepared with wheat semolina was used as control to compare developed foxtail millet vermicelli. Dough properties revealed variations across the different levels of unprocessed foxtail millet flour incorporation. The dough of control sample (100% wheat semolina) was creamish brown, stretchable and sticky. Strands were long, firm and sticky. Cooked vermicelli was creamish in colour with good strength, firm texture and no starchy mouth coating was observed, leached out water after the cooking was clear and vermicelli were found to be highly acceptable. When foxtail millet flour was incorporated at 20 per cent (T1), resulted dough was light creamish in colour, less stretchable and less sticky and vermicelli strands from this dough was long, firm and less sticky. Cooked vermicelli was whitish in colour with good strength and firm texture without starchy

mouth coating, leached out water was clear and it was acceptable. As the level of unprocessed foxtail millet level was increased in the formulations from 30 to 40 per cent (T3 and T4), the resulted vermicelli strands were less firm, less sticky and broke easily without any force. It showed less strength with starchy mouth coating. Resulted vermicelli was unacceptable. It was because as the level of semolina was reduced in the composite mix flour, gluten content also reduced gradually along which provides strength and elasticity to the dough and vermicelli strands (Table 2).

Optimization of addition of steamed foxtail millet flour in place of foxtail millet for development of vermicelli:

To improve the strength of foxtail millet flour, foxtail millet was partially gelatinized by steaming (Fig.1) for improving the vermicelli quality as suggested in the literature. Millets were steamed for 20 min, cabinet dried for 8 hrs and then milled in to fine flour (fig 1). Quality characteristics of vermicelli prepared with steamed foxtail millet flour are given Table 3. Vermicelli with upto 50 per cent (T4, T5 and T6) steamed foxtail millet flour had long, firm and sticky strands. Cooked vermicelli were acceptable with good strength, non sticky, firm, long and separate strands. Starchy mouth coating was absent. Increased strength of vermicelli strands were because of pre-gelatinization of foxtail millet flour which enhanced the strength of foxtail millet flour for vermicelli making. The steamed foxtail millet flour incorporation level was further increased to 60 per cent (T7). The dough was off white, non stretchable and less sticky. The cooked vermicelli was creamish in colour with poor strength, stickiness and starchy mouth feel was present so it was not acceptable. Poongodi *et al (2010),* also found that steaming of millet enhanced pasting properties of millet based vermicelli. Hence, previous trial with 50 per cent steamed foxtail millet was chosen for addition of functional ingredient black gram dhal to improve the functional quality and therapeutic value of foxtail millet vermicelli.

Optimization of black gram dhal flour for preparation of vermicelli:

Optimization of black gram dhal flour for the development of vermicelli is given in Table 4**.** Black gram dhal was replaced with semolina at 10, 15, 20 and 25 per cent level. As the level of black gram flour was increased from 10 to 20 percent the appearance and quality of resulted vermicelli improved. Resulted vermicelli was more whitish in colour. The strands were long and firm. The strength of vermicelli strand improved. Cooked vermicelli has very good strength, strands were non sticky and starchy mouth coating was absent. It was because of the good viscosity of black gram which in turn enhanced the pasting property of vermicelli. Camire et al also reported that protein enhancement in composit mix flour improved the functional properties of pasta. As the level was increased from 20 to 25 percent (Sample T11), cooked strands were smooth and separate, but slight after taste and flavour of black gram dal was sensed for 25 per cent incorporation level. Hence the foxtail millet vermicelli with 20 per cent black gram dhal was chosen for further value addition with therapeutic ingredients like fenugreek seed powder.

Optimization of fenugreek seed powder in development of vermicelli

Fenugreek is one of the functional ingredients known for its high soluble fibre content, hypoglycemic and hypocholestrolemic effect. So, an attempt was made to incorporate fenugreek seed powder into composit mix flour in order to enhance the therapeutic value of vermicelli. Fenugreek seed powder was incorporated at 1, 2 and 3 per cent level (T12, T13, T14) by replacing wheat semolina in developed composite mix flour (Table 5). Vermicelli with 1 per cent fenugreek seed powder (T12) exhibited very good strength. Stickiness in the strands was absent, starchy mouth coating was absent, strands of vermicelli was firm and smooth and starchy mouth coating was absent. As the level of fenugreek seed powder was increased (T13 and T14) the quality of strands improved but strong flavor and aftertaste of fenugreek seed

was there. So beyond fenugreek seed powder incorporation beyond 1 per cent was not acceptable. Hence, 1 per cent fenugreek seed powder incorporated vermicelli (T12) was chosen for further study.

Optimization of vermicelli preparation for different processing conditions

For the development of vermicelli, optimization was done for water addition required for the kneading of the dough. The water was added at different levels (45ml, 65 ml and 75 ml) for kneading 100 gm of flour (Table 6). The minimum amount of water required for preparation of dough was 45 ml, but the prepared dough was found to be very hard and very difficult for extrusion of vermicelli. Water level was increased up to 65 ml, Medium hard dough was formed which resulted in good extrusion quality. The vermicelli stands were separate and firm in texture. The treatment with 75 ml of water resulted in soft dough which was very easy to extrude but the formed vermicelli stands were sticky. Hence, 65 ml of water addition was accepted and was used in further experiments. Optimization for kneading time of 100 g of flour was done by kneading the dough for different time intervals *viz.*, 3 min, 4 min and 5 min. When dough was kneaded for 3 minutes, dough could not be formed properly and when kneading time was increased to 4 minutes rough dough was formed which was not suitable for extrusion of vermicelli. However, kneading of dough for 5 minutes resulted in smooth and uniform dough which was suitable for vermicelli extrusion; hence it was accepted for further experiments. For gluten development dough has to be kept for certain time before extrusion of vermicelli. To optimize the keeping time, dough was kept for different time intervals *viz.* 15, 30, and 60 minutes respectively, at room temperature. When dough was kept for 15 minutes no changes were observed (Table 6), as the time was too short for gluten development. When keeping time was increase up to 30 minutes dough became slightly smooth but it was not completely developed. Whereas, when dough was kept for 60 minutes it became soft and smooth resulting in complete dough development. Hence this was accepted for further experiments.

For the optimization of drying time (Table 6) vermicelli was dried at different time intervals viz. 1 hour, 2 hour and 4 hours by keeping the temperature constant at 60^0C. When vermicelli was kept for 1 hr it did not dry completely. When drying time was increase up to 2 hrs, it partially dried. Whereas, extending the drying time to 4 hrs at 60^0C resulted in complete dried strands.

Table 1: Composition of different trials of vermicelli tried for optimization

Sample	Semolina (%)	Unprocessed foxtail millet flour (%)	Steamed foxtail millet flour (%)	Black gram dhal flour (%)	Fenugreek seed flour (%)
C	100	-----	-----	-----	-----
T1	80	20	-----	-----	-----
T2	70	30	-----	-----	-----
T3	60	40	-----	-----	-----
T4	70	-----	30	-----	-----
T5	60	-----	40	-----	-----
T6	50	-----	50	-----	-----
T7	40	-----	60	-----	-----
T8	40	-----	50	10	-----
T9	35	-----	50	15	-----
T10	30	-----	50	20	-----
T11	25	-----	50	25	-----
T12	29	-----	50	20	1
T13	28	-----	50	20	2
T14	27	-----	50	20	3

Table 2: Optimization of unprocessed foxtail millet flour in the development of vermicelli

Sample	WS : UFMF	Dough properties	Strand formation	Cooked vermicelli quality
C	100: 00	Creamish brown, stretchable and sticky	Long, firm and sticky	Creamish, good strength, firm texture, No starchy mouth coating, clear leached out water, highly acceptable.
T1	80: 20	Light creamish, less stretchable and less sticky	Long, firm and less sticky	Whitish, good strength, firm texture, starchy mouth coating absent, acceptable, leached out water clear.
T2	70: 30	Light creamish, less stretchable and less sticky	Breakable, less firm and less sticky	Whitish, less strength, less firm texture, starchy mouth coating present, little sticky, short and broken strands, solid losses in leached out water, not acceptable
T3	60: 40	Off white, non stretchable and less sticky	Easily breakable, less firm and non sticky	creamish, poor strength, poor texture, sticky and easily breakable strands, starchy mouth coating present, too much solid loss in leached out water, not acceptable

WS- Wheat Semolina, UFMF -Unprocessed Foxtail Millet Flour

Table 3: Optimization of steamed foxtail millet flour in the development of vermicelli

	WS: SFMF	Dough properties	Strand formation	Cooked vermicelli quality
C	100:0	Creamish brown, stretchable and sticky	Long, firm and sticky	Creamish, good strength, firm texture, No starchy mouth coating, clear leached out water, highly acceptable.
T4	70: 30	Light creamish, stretchable and sticky	Long, firm and sticky	Off-white in colour, very good strength, no stickiness, no starchy mouth coating, firm long and separate strands, acceptable
T5	60:40	Light creamish, stretchable and sticky	Long, firm and sticky	Creamy- white in colour, good strength, no stickiness, no starchy mouth coating, firm long and separate strands, acceptable
T6	50:50	Dark creamish, less stretchable and less sticky	Breakable, firm and less sticky	Cream colour, little less strength, no stickiness, starchy mouth coating absent, firm long and separate strands, acceptable
T7	40:60	Off white, non stretchable and less sticky	Easily breakable, less firm and non sticky	Cream colour, poor strength, slightly sticky, slightly starchy mouth coating, weak and separate strands, not acceptable

WS- Wheat Semolina SFMF –Steamed Foxtail Millet Flour

Table 4: Optimization of black gram dhal flour in the development of vermicelli

	WS:SFMF:BF	Dough properties	Strand formation	Cooked vermicelli quality
T8	40:50:10	Creamish white, less stretchable and less sticky	Breakable, firm and less sticky	Cream colour, good strength, no sticky, starchy mouth coating absent, firm smooth and separate strands, acceptable
T9	35:50:15	Creamish white, less stretchable and less sticky	Breakable, firm and less sticky	Cream colour, very good strength, less sticky, no starchy mouth coating, firm smooth and separate strands, acceptable
T10	30:50:20	White, stretchable and sticky	Long, firm and sticky	Creamish-white colour, very good strength, not sticky, starchy mouth coating was absent, very firm ,smooth and separate strands, highly acceptable, no after taste
T11	25:50:25	White, stretchable and sticky	Long, firm and sticky	Cream colour, good strength, stickiness-absent, starchy mouth coating- absent, firm smooth and separate strands, after taste of black gram dhal was present, not acceptable

WS- Wheat Semolina; SFMF –Steamed Foxtail Millet Flour; BF- Black gram dhal flour

Table 5: Optimization of fenugreek seed powder in the development of vermicelli

	WS: SFMF: BF: FSP	Dough properties	Strand formation	Cooked vermicelli quality
T12	29:50:20:1	White, stretchable and sticky	Long, firm and sticky	Creamish-white colour, very good strength, stickiness-absent, starchy mouth coating- absent, very firm ,smooth and separate strands, acceptable
T13	28:50:20:2	White, stretchable and sticky	Long, firm and sticky	Creamish-white colour, very good strength, stickiness-absent, starchy mouth coating- absent, very firm ,smooth and separate strands, , flavour of fenugreek was present, not acceptable
T14	27:50:20: 3	White, stretchable and sticky	Long, firm and sticky	Creamish-white colour, very good strength, stickiness-absent, starchy mouth coating- absent, very firm ,smooth and separate strands, strong flavour of fenugreek, not acceptable

SFMF –Steamed Foxtail Millet Flour; BF- Black gram dhal flour; WS- Wheat Semolina; FSP- Fenugreek Seed Powder

Table 6: Optimization of vermicelli preparation for different processing conditions

Different processing conditions	**Variations in water added (ml)**				**Variations in kneading time (min)**			
Sample	**Control vermicelli (Semolina)**	**Foxtail millet vermicelli**			**Control vermicelli (Semolina)**	**Foxtail millet vermicelli**		
	80	**45**	**65**	**75**	**7**	**3**	**4**	**5**
Descriptive characteristics	Smooth and soft, stretchable, easy to extrude, smooth, separate and firm strands	Crumbly dough, difficult to extrude, un uniform broken strands after extrusion	Optimum quality dough, can easily extrude, separate and firm strands.	Soft dough, difficult to extrude, sticks to vermicelli moulds, sticky vermicelli strands	Uniform consistency dough, easy to extrude, uniform, firm and strong strands	Dough could not formed, hard dough, difficult to extrude, no uniform and long strands	Hard dough, difficult to extrude, broken strands	Smooth and optimum consistency dough, easily extrudable, smooth, uniform and non sticky strands

Different processing conditions	**Variations in keeping time (min)**				**Variations in drying time (Hr)**			
Sample	**Control vermicelli (Semolina)**	**Foxtail millet vermicelli**			**Control vermicelli (Semolina)**	**Foxtail millet vermicelli**		
	60	**15**	**30**	**60**	**1**	**1**	**2**	**4**
Descriptive characteristics	smooth and soft dough, stretchable and sticky, Easily extrudable but sticky	No effect on dough development (gluten development)	Dough became slightly smooth	Smooth and soft dough	Completely dried, firm and strong strands	Not dried, weak and breakable strands	Did not dried properly	Dried completely

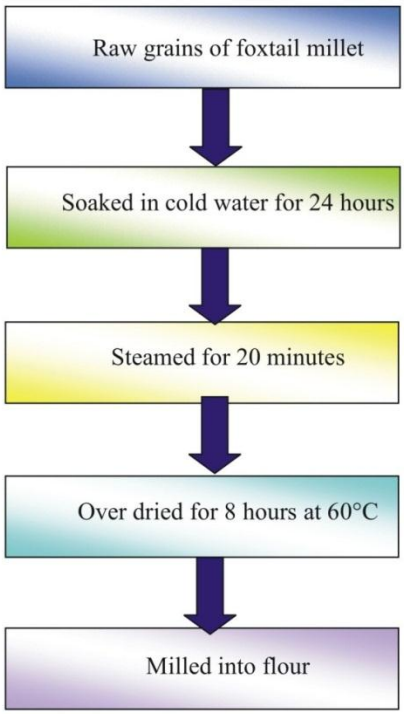

Fig. 1: Preparation of foxtail millet flour

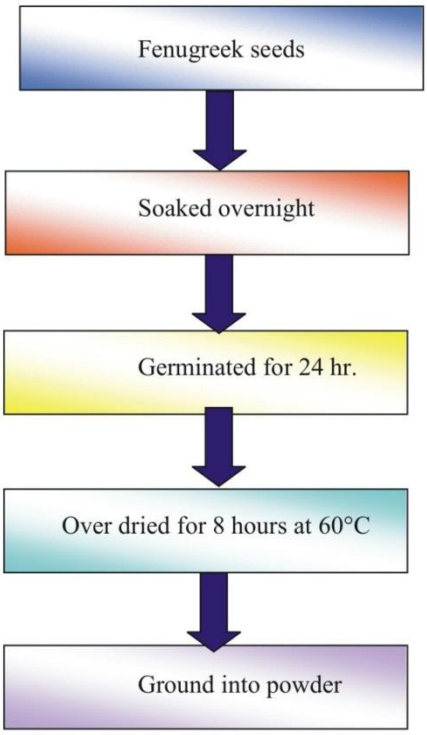

Fig. 2: Preparation of fenugreek seed powder

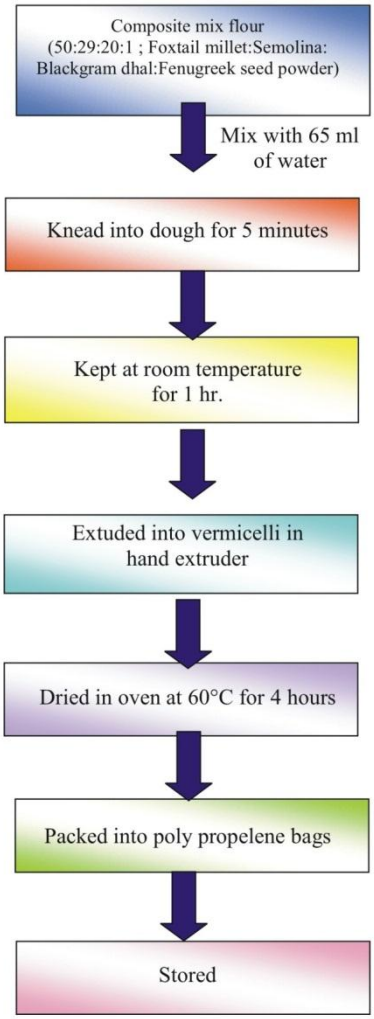

Fig. 3: Flow chart for developed foxtail millet vermicelli

CONCLUSION

This study revealed that substitution of semolina in vermicelli formulation with different functional component viz. foxtail millet, black gram and fenugreek seed powder affected the physical, chemical, textural and sensory properties of the noodles. A 50% blend of finger millet, 20% black gram and 1 per cent of fenugreek seed powder with semolina was most efficiently used in the vermicelli formulation. A 50% blend of finger millet, 20% black gram and 1 per cent of fenugreek seed powder with semolina was most efficiently used in the vermicelli formulation. Vermicelli thus formulated showed excellent pasting properties and higher nutritional value with higher dietary fibre content. Present data suggest that vermicelli added with Foxtail millet and black gram dal may be an alternative for people with special caloric or metabolic requirements.

REFERENCES

1. Camire, M.E. and King, C.C., Protein and fibre supplementation effects on extruded corn meal snack quality. J. Food Sci., 56: 760-763 (1991).
2. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)/Food and Agriculture Organization (FAO), The World Sorghum and Millet Economies. ICRISAT, Patancheru, India/ FAO, Rome (1996).
3. Kotagi, K., Chimmad, B., Naik, R.K. and Kamatar, M.Y., Nutrient enrichment of little millet (panicum miliare) flakes with garden cress seeds. *International Journal of Food and Nutritional Sciences*, **2(3):** 36-39 (2013).
4. Poongodi, V. T., Mohankumar, J. B. and Srinivasan, T., Quality evaluation of noodles from millet flour blend incorporated composite flour. *J. Sci. Ind. Res.,* **69:** 48–54 (2010).
5. Singh, D.S., Garg, S.K., Singh, M. and Goyal, N., Effect of major processing parameters on the quality of extrudates made out of soy-kodo blends. *J. Food Sci. Technol.* **43(4):** 434-437 (2006).