

Development of cold extruded products (Vermicelli & Pasta)

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Received : 29.01.2014; Revised : 08.08.2014; Accepted : 22.08.2014

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■ **ABSTRACT** : An attempt was made to develop millets' based cold extruded products (vermicelli and pasta) and to study their storage. Five small millets' (barnyard, foxtail, kodo, little and proso) were used in the study. Small millets flour, wheat and soy flours were used in the ratio of 50: 40: 10 for the development of cold extruded products. Vermicelli kheer and pasta masala were prepared from all the five millets and were subjected to sensory evaluation along with control (wheat based vermicelli). Sensory results showed that the millets kheer were more acceptable and foxtail millet kheer was better preferred followed by kodo and proso millet kheers. The millets pasta masalas were also very much acceptable compared to control. Among the millets, proso millet pasta masala was more preferred for its sensory attributes followed by kodo millet. Nutritional analysis of stored vermicelli showed not much variation in composition before and after storage irrespective of packaging material. Both the gauges of package (300 and 400 PE) were found suitable for storing vermicelli up to two months without affecting the quality.

■ **KEY WORDS** : Barnyard millet, Foxtail millet, Kodo millet, Little millet, Proso millet, Pasta machine, Polyethylene cover

■ **HOW TO CITE THIS PAPER** : Ranganna, B., Ramya, K.G., Kalpana, B. and Veena, R. (2014). Development of cold extruded products (Vermicelli & Pasta). *Internat. J. Agric. Engg.*, 7(2) : 360-364.

India is the leading producer of small millets namely, finger millet (*ragi*), kodo millet (*kodo*), foxtail millet (*kangni*), barnyard millet (*sawan*), proso millet (*cheema*) and little millet (*kutki*) (Majumdar *et al.*, 2006).

The important small millets grown in India are finger millet (*Eleusine coracana*) barnyard millet (*Echicholafrumentacea* Link), foxtail millet (*Satariaitalica*), kodo millet (*Paspalumscobiculatum*), little millet (*Panicummiliare* Lamk.) and proso millet (*Panicummilliaceam*). The cultivation of kodo millet, little millet and foxtail millet is more seen in Madhya Pradesh, Chhattisgarh, Orissa, Tamil Nadu, Jharkhand, Karnataka, Andhra Pradesh and Maharashtra. The barnyard and proso millets are largely grown in Uttaranchal state. Finger millet is a major staple food of people of southern Karnataka, and some parts of Tamil Nadu. The millets have been used in human consumption from pre-historic time and they are considered as the way of life, food of the people and food for hungry. The millets are with higher fibre content, and their protein quality and mineral composition contribute significantly to nutritional security of a large section of population residing in the millet growing areas, considered to be the most disadvantaged groups (Desai *et al.*, 2010).

Processed vermicelli products are commercially available

in brand names and they are easy to cook with least time and effort. Since, the commercially available vermicelli is made out of only refined wheat flour/semolina, the calorific value as well as protein content and quality, rank equally well with any other cereal.

In the developed countries, many convenience foods have been developed by extrusion technology and these extruded products are very popular among the consumers. These products include spaghetti, macaroni, vermicelli and noodles.

Archana (2001) also reported that pasta prepared from pearl millet and fenugreek (80:20) were found very much acceptable. Varsha and Grewal (2003) showed that supplementation of pearl millet and soy flour at 15 per cent each in the preparation of noodles did not affect the physical and sensory qualities of noodles.

Dod *et al.* (2003) performed sensory evaluation of pearl millet based vermicelli using pearl millet flour, chick pea flour and refined wheat flour in different proportions. Almost similar results were observed for the vermicelli cooked in salted form where as Type 1 (50:30:20) scored the highest mean scores for all sensory attributes. Also Type 1 (50:30:20), type V (50:50:0) and type VI (60:40:0) vermicelli were found very much acceptable in all their characteristic appearance and texture.

The overall acceptability of vermicelli sweet preparation was found to be better compared to the one prepared in salted form, attributing to the condiments used in the preparation.

Packaging of extruded products is necessary to prevent contamination and damage during transport and storage. Cellophane material is used primarily for packaging of extruded products. It provides clarity as well as protection against insect and moisture. Low density polyethylene bags are often used for packaging of extruded products.

Sowbhagya and Ali (2000) developed maize vermicelli with and without antioxidant and packed in cast polypropylene (CPP) and a laminate of metalized polyester with low density polyethylene (M-PET/PE). The packs were stored at 38°C, 92 per cent RH (accelerated storage) for 100 to 140 days. The sensory properties of the cooked product remained good up to 100 days.

In the present study, an attempt was made to develop small millets based cold extruded products like vermicelli and pasta and their recipes including their shelf-life studies. Five small millets were employed in the study.

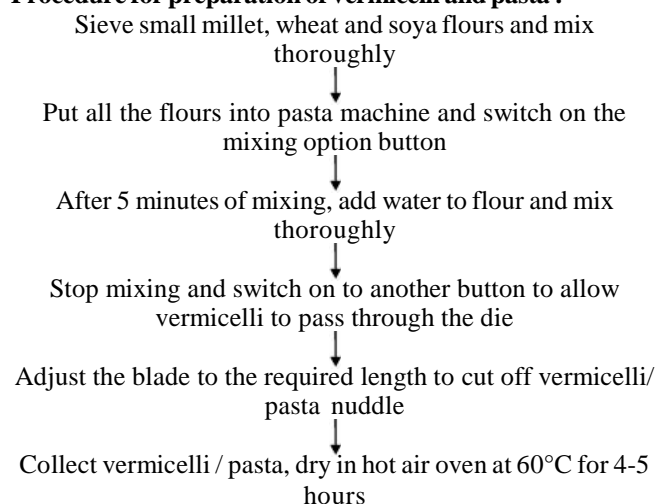
■ METHODOLOGY

Formulation of millet grain flour :

The dried raw millet rice were fed to the burr mill to get fine pulverized millet flour. This was further sieved using BS-60 mesh to remove rough particles, if any, in the flour.

Millet	Millet flour (%)	Wheat flour (%)	Soya flour (%)	Water (ml)
Barnyard	50	40	10	550
Foxtail	50	40	10	550
Kodo	50	40	10	550
Little	50	40	10	550
Proso	50	40	10	550

Procedure for preparation of vermicelli and pasta :



Development of cold extruded (vermicelli and pasta) recipes :

Vermicelli kheer and pasta masala were prepared from the developed cold extruded products from small millets.

Storage studies of cold extruded products :

The best millet (foxtail) was selected from vermicelli kheer and pasta masala based on results of sensory evaluation, then packaged and stored for 2 months at ambient temperature. Low density polyethylene package was used with two thicknesses (300 and 400 gauges).

Nutritional evaluation of the developed products and stored vermicelli :

The nutritional components of the cold extruded products were analyzed according to AOAC Method (1980). The stored vermicelli products were subjected to biochemical analysis to study the effect of storage on proximate composition.

Sensory evaluation (vermicelli kheer and pasta masala) :

The two products, namely, vermicelli kheer and pasta masala were evaluated for sensory parameters on a 5 point Hedonic Scale (Ranganna, 1991) by a panel of ten judges for the appearance, texture, aroma, taste and overall acceptability. The nutritional components of the cold extruded products were analyzed according to AOAC Method (1980).

■ RESULTS AND DISCUSSION

The biochemical analysis (proximate analyses) was done to determine the different nutritional components of the developed pasta and vermicelli, using standard procedures.

Protein :

The highest protein content was recorded in proso millet vermicelli/pasta (16.39) followed by foxtail, little, barnyard and kodo millets vermicelli pastas and the control sample (10.62). The mean values of vermicelli/pasta of all five millets along with control are presented in Table 1. Highest protein content observed in millets vermicelli/pasta is due to high protein content of millets and soya flour.

Fat :

The mean values of small millets ranged from 0.12 to 2.88g (Table 1). Highest fat content was recorded in barnyard millet vermicelli (2.88g) followed by of foxtail, proso, little and kodo millets vermicelli/pastas and the lowest in control sample (0.12g). The highest fat content in millet vermicelli/pastas was basically due to higher fat content in small millets.

Ash :

The highest ash content was observed in barnyard millet vermicelli, pastas compared to other millets vermicelli, pastas

and control (0.57 to 2.05g), and the lowest in kodo millet (1.71g) (Table 1).

Crude fibre :

The mean crude fibre content of all five millet vermicelli, pastas and the control ranged from 0.16 to 1.86g (Table 1). The highest was recorded in proso millet (1.86g) and the lowest in control sample (0.16g). The crude fibre content was high in millet based products compared to control due to high fibre content in small millets.

Carbohydrate :

The carbohydrate value of all the five millets vermicelli, pastas and the control ranged from 71.14 to 78.95g. The highest was recorded in the control (78.95g), and the lowest in barnyard millet vermicelli and pasta (Table 1).

Moisture :

The moisture content of vermicelli/pasta from all the five millets along with control was found to be in the range of 6.88 to 9.74 per cent (Table 1). The highest moisture content was recorded in the control sample (9.74 %) and the lowest in foxtail millet (6.88 %) followed by the products of little, proso, kodo and barnyard millets.

Calcium :

The highest calcium content was recorded in foxtail millet vermicelli and pasta (0.06mg) and the lowest in control (0.02mg) sample. The calcium content was nearly three times higher

compared to control due to high calcium content in millets thus responsible for enhanced calcium content in the final product.

Iron :

The highest mean value of iron was recorded in proso millet (0.016 mg) and the lowest in control sample (0.002 mg). The iron content was observed very high in small millets based products compared to control.

Phosphorous :

Highest phosphorous contents were observed in barnyard millet vermicelli/pasta (0.35 mg) and foxtail vermicelli pasta (0.34 mg) lowest in control 0.10 mg (Table 1). The phosphorous values ranged from 0.10 to 0.35 mg.

Sensory evaluation of cold extruded millet products :

The organoleptic evaluation of prepared small millets' vermicelli and pasta masala was done by a panel of ten judges on a 5 point Hedonic scale.

Appearance :

The mean sensory scores showed that there was a significant difference among millets and control (Table 2). The scores for appearances ranged from 3.60 to 5.00. The highest was recorded for control followed by foxtail, kodo and proso millets kheers each scoring 3.80. The lowest sensory scores (3.60) were recorded for barnyard and little millets kheers.

Table 1 : Nutritional analysis of millet based vermicelli/pasta (per 100 g)

Millet	Carbohydrate (g)	Protein (g)	Fat (g)	Ash (g)	Crude fibre (g)	Moisture (%)	Calcium (mg)	Iron (mg)	Phosphorus (mg)	Energy (kcal)
Barnyard	71.14	15.08	2.88	2.05	1.48	8.85	0.052	0.012	0.35	370.80
Foxtail	72.61	16.17	2.35	1.99	1.36	6.88	0.060	0.013	0.34	376.27
Kodo	75.20	13.99	0.74	1.71	1.06	8.36	0.040	0.014	0.28	363.42
Little	73.03	15.69	1.72	1.96	1.28	7.60	0.040	0.012	0.29	370.36
Proso	71.47	16.39	1.90	1.98	1.86	8.26	0.040	0.016	0.29	368.54
Control (wheat)	78.95	10.62	0.12	0.57	0.16	9.74	0.020	0.002	0.10	359.36

Table 2 : Sensory evaluation of vermicelli kheer from small millets

Millet	Appearance	Texture	Aroma	Taste	Overall acceptability
Barnyard	3.60	3.60	3.60	3.80	3.80
Foxtail	3.80	4.00	3.60	4.00	4.00
Kodo	3.80	4.00	3.60	4.00	4.00
Little	3.60	3.40	3.20	3.20	3.20
Proso	3.80	3.40	3.80	3.60	3.40
Control	5.00	4.00	4.40	4.20	4.40
F test	*	*	*	*	*
C.D. (P=0.05)	0.58	0.50	0.85	0.73	0.53
S.E. \pm	0.20	0.17	0.29	0.25	0.18

Texture :

The mean texture scores ranged from 3.40 to 4.00. A significant difference was observed between the millets' kheers and control. The highest score (4.00) was recorded for foxtail and kodo millets kheers and control. The texture of millets' kheer was fully comparable to control.

Aroma :

The millets' vermicelli kheer exhibited little bit of millets' flavor compared to control (without millet flour), and therefore highest score was recorded for control (4.40) sample followed by proso millet kheer (3.80) (Table 2). There was a significant difference among millets' kheers and control.

Taste :

Significant differences were observed among millets' kheers and control. The highest sensory score was recorded (4.20) for control sample followed by foxtail and kodo millet kheer (4.00). The least was recorded for little millet kheer (3.20).

Overall acceptability :

The highest sensory score (4.40) was recorded for control sample followed by foxtail and kodo millet (4.00) kheers. A significant difference was observed among millets and control (Table 3). The sensory scores showed that millets' vermicelli kheers were found to be acceptable in respect of all the four sensory qualities studied.

Appearance :

No significant differences observed among millet's pasta and control. The highest score was recorded in both control and kodo millet pasta masala (4.40). The millets' pasta masala were more acceptable than the control.

Texture :

The mean scores ranged from 3.40 to 4.00. No significant difference observed between the millets pasta masala and control. Proso millet pasta masala was more preferred (4.00) compared to control (3.60).

Aroma :

In respect of aroma also, proso millet pasta masala scored highest (4.00) compared to control. Significant differences were observed among millets pasta masala and control (Table 4). Due to the influence of aroma, millets pastas masala were highly preferred compared to control.

Taste :

The highest score was recorded for proso millet pasta masala (4.00) followed by foxtail and barnyard millets pastas masala (Table 3). The least was recorded for control sample (3.40).

Overall acceptability :

The highest score was recorded for proso and kodo millet pasta masala, and control sample (4.00). Significant differences were observed among millets pasta masalas and control. The

Table 3 : Sensory evaluation of small pasta masala product

Millet masala	Appearance	Texture	Aroma	Taste	Overall acceptability
Barnyard	4.20	3.40	3.80	3.80	3.20
Foxtail	4.20	3.60	3.60	3.80	3.60
Kodo	4.40	3.80	3.60	3.60	3.80
Little	4.00	3.40	4.00	3.80	4.00
Proso	4.20	4.00	4.00	4.00	4.00
Control	4.40	3.60	3.60	3.40	4.00
F test	NS	NS	NS	NS	*
C.D. (P=0.05)	0.58	0.73	0.67	0.69	0.69
S.E. ±	0.20	0.25	0.23	0.23	0.23

NS = Non-significant

Table 4 : Nutritional analysis of stored small millets vermicelli stored at ambient temperature for 2 month

Millet/package	(Per 100 g)									
	Carbohydrate (g)	Protein (g)	Fat (g)	Ash (g)	Crude fibre (g)	Moisture (%)	Calcium (mg)	Iron (mg)	Phosphorus (mg)	Energy (kcal)
First day of storage	72.61	16.17	2.35	1.99	1.36	6.88	0.060	0.013	0.34	376.27
PE 400 gauge after 2 months	70.58	16.66	2.73	2.03	0.51	8.00	0.47	0.015	0.36	373.53
PE 300 gauge after 2 months	69.62	16.92	3.32	2.00	0.60	8.14	0.52	0.014	0.36	376.04

overall acceptability scores revealed that millets pasta masalas were equally preferred compared to control with additional nutrition.

Storage of small millet vermicelli :

The foxtail millet packages of both 300 and 400 gauge stored at ambient temperature were evaluated for nutritional composition.

An increase in moisture and protein content was observed in both type of packaging material studied before storage and at the end of two months of storage. The least increase of moisture content was observed in 400 gauge low density polyethylene package (8.00 % and 16.66g, respectively). In case of fat, ash and calcium contents there was an increasing trend from first day up to two months storage, and lowest increase was observed in 400 gauge low density polyethylene package (2.73g, 2.03g and 0.47mg). Crude fibre and carbohydrate contents were decreased from first day up to end of final storage period, and least decrease was noticed in 400 gauge packages. Not much variations were observed in iron and phosphorous contents irrespective of packaging material.

Conclusion :

The sensory scores of millets based vermicelli kheer were observed to be on par with control. The millets' kheers were more preferred. Among the millets, foxtail millet kheer was highly preferred for its sensory parameters followed by kodo and proso millets' kheers. The sensory scores of millets' pasta masala were found high compared to control. Among the millets proso millet pasta masala was more preferred for its sensory parameters followed by kodo millet pasta masala.

The storage studies demonstrated that there was hardly any change observed in the physical characteristics like appearance, flavor and texture even after two months of storage. Among the two packages, 400 gauge low density polyethylene proved better compared to 300 gauge polyethylene. The study showed that the small millets' flours could be successfully incorporated for developing cold

extruded products like vermicelli and vermicelli kheer, as they supplement additional protein and fibre which could be safely preserved for two months to enable marketing and consumption.

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