Standardization and evaluation of high fibre convenient food from oats flour

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ABSTRACT

Extrusion is one of the modern technologies used for the preparation of convenience foods. It is used worldwide for the production of expanded snack foods, ready to eat cereals, baby foods, pasta and pet foods. The present study focused on the use of oats flour for production of ready-to-cook vermicelli by extrusion technology. Oats vermicelli was developed from blends of oats flour and refined wheat flour at different level of incorporation. The nutritional properties namely, protein, fat, starch and dietary fibre of the oats vermicelli analyzed. The findings of the study revealed that oats vermicelli was on par with control vermicelli in all aspects of studied variables.

Key words: Extrusion, high fibre, oats flour, vermicelli.

Indian eating habits are undergoing tremendous changes especially in urban population. Due to the numerous health benefits, there is an increased consumption of cereals in the form of whole grain or cereal based processed foods (Bhavya and Prakash, 2012). Advancements in protein modification would create a new generation of functional ingredients that will be helpful in new product development. Spaghetti, noodles and other pasta products are the important food uses of cereals particularly wheat, rice and maize. Cereals are also used to make several sweets and snack items. Raw and roasted, green seeds of cereals (wheat, barley, maize and sorghum) are consumed in several states of the country (Panghal *et al*., 2006). Convenience foods are defined as item that requires little or no preparation. Convenience foods are available in many forms (Kannan and Anitha, 2013) Breakfast is the most important meal of the day and breakfast cereals offer the most nutrient dense and lowest fat choice at breakfast time. They are convenience foods made from processed grains, which needs very little time for cooking (Fathima *et al.*, 2013). Extrusion cooking is one of the latest technology used for the preparation of convenience foods. Extruded products are prepared mainly from wheat, as well as rice and from other sources. They have become major products of the cereals food industry and are popular on account of their sensory appeal, low cost, ease of preparation, storage stability and the increased consumer acceptability in ethnic foods (Sowbhagya and Ali, 2001). Extrusion cooking is used worldwide for the production of expanded snack foods, ready to eat cereals, baby foods, pasta and pet foods (Deshpande and Pashadri, 2011). A low fibre diet contributes, to the development of heart disease, obesity, cancer and type 2 diabetes. Among the various disease condition diabetes mellitus is recognized as an epidemic disease in most countries that are undergoing socioeconomic transitions. Controlled studies carried out in India as well as in many other countries have revealed that high fibre intake offers protection against diabetes (Kavitha *et al.*, 2001). Cardiovascular disease (CVD) is the leading cause of death in most developed countries. The health benefits from consumption of dietary fibre from cereal grain have increased interest in oats dietary fibre. Dietary fibre is the portion of plant cells that is not digested in the human small intestine and can affect utilization of food by the body. Oats (*Avena sativa* L.) formed the staple diet for a large part of the population. Later oats was replaced by other cereals and other foods. Today, because of their active and natural substance, oats have regained the image of a very healthy dietary

ingredient. The high nutritional value of oats is one reason for its popularity and its increased human consumption.

The water soluble dietary fibre (1-3) (1-4)-β-D-glucan of oats is of particular importance to human nutrition (Zhang *et al.*, 1998 and Lapvetalainen *et al*., 2001). The soluble fibre β-glucan has a moderating effect on postprandial blood glucose and insulin response and reduces elevated blood cholesterol levels (Lyly *et al.*, 2003). Oats contains 4.1 to 4.9 per cent soluble, 6.0 to 7.1 per cent insoluble and 10.2 to 12.1 per cent total dietary fibre (Manthey *et al.*, 1999). Food and Drug Administration announced that the fibre from oatmeal may reduce the risk of heart disease (Anon, 2006a). Because of its low cost and continuous processing capability has been accepted as one of the most useful technologies during the recent years in the field of food processing. Hence, the present study focused on standardization and evaluation of high fibre convenient food item from oats flour.

MATERIALS AND METHODS

The research work was carried out in the Department of Food Science and Nutrition, Home Science College and Research Institute, Madurai, India. Oats was purchased from IARI, New Delhi. Refined wheat flour was purchased from the local departmental stores, Madurai.

Processing of oats grain

Milling of oats

Oats grains were dehulled and polished using a Satake Grain Testing Mill (TMO5 model, Satake Engineering Co., Japan) for 180 seconds. The resulting grain is the groats. The milled samples were sieved in a BS 60 mesh sieve. Then the groats was ground into flour it known as oats flour which is used for development of fibre rich vermicelli.

Pasting properties of oats flour

The Rapid Visco Analyser (Newport Scientific Pty. Ltd, Australia) was used to assess the viscosity of the product and amylase activity. The pasting properties of starch and starch containing products are readily assessed in the Rapid Visco Analyser. During the test, the starch is gelatinized with consequent rise in viscosity, subjected to high temperature and controlled shear during which its stability is revealed and then cooled to provide an indication of setback during gelation (AACC, 1995 and ICC, 1995).

Standardization of vermicelli

Extruded products, vermicelli was prepared from refined wheat flour and blending with oats flour in various levels (25, 50, and 75 %) and with oats flour only (Table. 1)

Table 1. Standardization of oats vermicelli

Ingredients (g)	Control	Percentage levels of incorporation			
		25	50	75	100
Refined wheat flour	100	75	50	25	-
Oats flour	-	25	50	75	100
Water (ml)	30	30	30	30	30
Salt	2	2	2	2	2

Refined wheat flour (control) and oats flour blends were sieved in a BS 60 mesh sieve, steamed for 15 minutes cooled, lumps were broken and sieved again. The flour was filled in the mixing compartment of the pasta-making machine and kneaded with water and salt for 15 min and extruded. The extruded vermicelli was steamed for five minutes and dried in a cabinet driver at 60^{o}C for two hours. The products were cooked in boiling water and evaluated sensory attributes and its acceptability by using 9 point hedonic scale Srilakshmi (2006).

Nutrient content of vermicelli

Oats flour incorporated vermicelli was evaluated for chemical constituents such as moisture content of the sample estimated by hot air oven method, protein was determined by available nitrogen in the sample by microkjeldhal method in Kjel plus (Pelican equipment, India), fat estimated by soxhlet extraction in Socs plus (Pelican equipment, India) by using standard procedure (AOAC, 2005). The starch and fibre content were estimated by anthrone method (Sadasivam and Manickam, 2008) and acid and alkali method (AOAC, 2000) respectively. The β-glucan of the vermicelli were estimated by Trevelyan and Harrison (1956) method.

Shelf life study

Vermicelli prepared out of oats flour was packed in 100g lots in 400 gauge polyethylene bags (P_1), 400 gauge metallised polyester polyethylene

laminated bags (P_2) and stored at room temperature for 120 days to find out the shelf stability.

Statistical analysis

The data obtained from the various experiments were subjected to statistical analysis to find out the impact of different treatments on the chemical composition of oats flour and quality of the developed products. Factorial Completely Randomized Design (FCRD) as per the method described by Gomez and Gomez (1984) was employed for the analysis with triplicate number of samples.

RESULTS AND DISCUSSION

Amylographic characteristics of oats flour

The amylographic characteristics of oats flour and refined wheat flour used for the vermicelli preparation were studied in Rapid visco analyzer and the result was presented in Table 2. The onset of gelatinization temperature was slightly higher for oats flour (51.5^{o}C) than refined wheat flour (50.5^{o}C). The peak viscosity of the refined wheat flour was 373 RVU, which remained a plateau for three min and then gradually decreased to hot paste viscosity of 20 RVU. While the peak viscosity of the oats flour was 318 RVU, the values dropped to 190 RVU and attained 388 RVU of final viscosity. The time taken to attain peak by refined wheat flour and oats flour were 4.1 and 6.1 min respectively. Temperature at peak viscosity of refined wheat flour was 95^{o}C and oats flour was 88^{o}C. Set back viscosity is a measure of recrystallisation of gelatinized starch during cooling. The changes in setback viscosity during cooling of starch paste are considered to be mainly due to amlyose molecular re-association. Paton (1981) reported that the Hinoat oats starch had a pasting temperature of 83^{o}C, 455 BU of peak viscosity, 85 BU hot paste viscosity and 245 BU of final viscosity.

Nutrient content of vermicelli

The nutrient composition of thevermicelli, such as the moisture content (%), starch, protein and fat content (g %) of oats vermicelli packed P_1 and P_2 were periodically analyzed during 120 days of storage and the same was given in Table 3. Moisture content of vermicelli gradually increased, irrespective of the packaging material. The vermicelli stored in P_1 had higher moisture content from 60 days of storage, while P_2 absorbed moisture after 90 days. However the statistical analysis proved that the moisture content increase during storage was not significant. This may be due to the barrier properties of the packaging films. The result supported by Sugasini (2003) stated that the increase in moisture content of legume incorporated wheat vermicelli packed in 200 and 300 gauge polyethylene bags gradually increased during 180 days of storage. The reduction in the starch content of vermicelli packed in different packaging materials was found to be negligible after 120 days of storage. The reduction of starch content of vermicelli was slightly higher in the samples packed in P_1 than P_2. This may be due to the gradual breakdown of starch into reducing and non reducing sugars as the storage period progressed. A decreasing trend in protein content of oats vermicelli during storage was observed. The statistical analysis of the data revealed that there was a significant influence on the protein content of storage period and packaging materials. Similar result reported by Gurumeenakshi (2001) there was 1.47 % of protein reduction observed in vermicelli and soy noodles at the end of 60 days of storage. The regarding the fat content, reduction was more in the samples packed in P_1 than P_2. At the end of storage period, the fat content got reduced from 4.20 to 3.98 g per cent in P_1 and 4.08 g per cent in P_2. The statistical analysis revealed that the changes in fat content during storage were not significant.

Crude fiber and β-glucan

The crude fibre and β-glucan content of developed oats vermicelli were evaluated during the storage period (Table 4)**.** After 120 days of storage period, there was a very minute change in crude fibre content. The statistical analysis of the data revealed that the change in crude fiber due to packaging materials and storage period was not significant**.** Whereas, gradual decrease in β-glucan content of oats vermicelli was noticed during storage. After 120 days of storage, reduction in the β-glucan content was more in samples packed in 400 gaugepolyethylene bags (P_1).

Sensory evaluation

The stored vermicelli was periodically evaluated to assess the acceptability of the products by using 9 point hedonic. The results indicated that the inclusion of oats flour did not adversely affect the

various organoleptic parameters. It was also found that the product prepared of 100 per cent oats flour was equally acceptable as that of products prepared out of refined wheat flour and oats flour blends. The stored vermicelli was highly acceptable up to 120 days of storage.

Table2.Amylographic study of oats flour

Particulars	Samples	
	Refined wheat flour	**Oats flour**
Onset gelatinisation temperature (^{o}C)	50.50	51.50
Peak viscosity (RVU)	372	318
Peak time (min)	4.1	6.1
Temperature at peak viscosity (^{o}C)	95	88
Hot paste viscosity (RVU)	20	190
Cold paste viscosity (RVU)	24	388
Set back viscosity (RVU)	348	70
Speed (rpm)	960	960

Table 3. Nutrient composition of vermicelli during storage

Storage days	**Moisture (%)**		**Starch (g%)**		**Protein (g%)**		**Fat (g%)**	
	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2
1	**6.17**	**6.17**	**67.20**	**67.20**	**19.20**	**19.20**	**4.20**	**4.20**
30	**6.17**	**6.17**	**67.19**	**67.20**	**19.20**	**19.20**	**4.20**	**4.20**
60	**6.19**	**6.17**	**67.15**	**67.18**	**19.17**	**19.20**	**4.15**	**4.15**
90	**6.19**	**6.18**	**67.05**	**67.12**	**19.17**	**19.20**	**4.00**	**4.12**
120	**6.20**	**6.19**	**66.95**	**67.07**	**19.10**	**19.18**	**3.98**	**4.08**

P_1 - 400 gauge polyethylene bags,
P_2 - 400 gauge metallised polyester polyethylene laminated bags

Table 4. Crude fibre and glucan content of vermicelli during storage

Storage days	**Crude fibre (g%)**		**β-glucan (g/100g)**	
	P1	**P2**	**P1**	**P2**
1	1.36	1.36	2.15	2.15
30	1.36	1.36	2.10	2.15
60	1.35	1.36	2.08	2.12
90	1.30	1.34	2.06	2.10
120	1.30	1.32	2.00	2.10

	Crude fibre		**β-glucan**	
	SED	**CD (0.01)**	**SED**	**CD (0.01)**
S	0.019	0.052^{NS}	0.029	0.081^{NS}
T	0.014	0.040^{NS}	0.023	0.063^{NS}
SP	0.032	0.090^{NS}	0.051	0.141^{NS}

CONCLUSION

The oats vermicelli with different blends of oats flour and refined wheat flour were prepared and studied for its properties. Among these blends, vermicelli from whole oats flour was on par with control vermicelli. The sensory evaluation revealed that oats flour vermicelli was found to be acceptable in all sensory attributes. Thus, Oats have high protein content with good nutritional quality when compared to other cereal grains. The developed of oats flour based convenience foods highly suitable food for diabetes and also for those who wish to shed excess body weight.

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