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Studies on Process Optimization of Little Millet Flour Based Pasta

P. Sudha[1], E. Tamilselvi[1], S. Preethivardhini[2] and S. Karthika[2]

ABSTRACT: *The aim of the study focused on the use of little millet for production of pasta using cold extrusion technology. The objective of the study is standardization of composition of millet flour for millet pasta, process optimization and quality evaluation of millet pasta. The composite flours were prepared using little millet flour and other flour fractions namely maida, soy flour and cow pea flour. The extrudate physical properties namely bulk density (BD), tapping density, expansion ratio (ER), water holding capacity (WHC), water absorbing index (WAI) and moisture retention (MR) were also analyzed. The result of the composite millet powder and maida (control) indicated that up to 50 % inclusion of millet flour with maida yielded good results and indicated that mass flow rate (MFR) 1.91 ± 0.12 g/s, tap density 0.73 ± 0.01 g/cc, bulk density (BD) 0.57 ± 0 g / cm^3, water soluble index (WSI) 0.36 ± 0 %, moisture retention (MR) 35.67 ± 0.4, expansion ratio (ER) 1.45 ± 0.31, water absorbing index (WAI) 3.14 ± 0.03 % and water holding capacity (WHC) 384.2 ± 0.07.*

Keywords: *Extrusion, Little millet, extrudate, maida.*

INTRODUCTION

In India different kind of traditional foods made from small millet grains, form staple diet for many rural and urban households. Millet is a starchy food with 25:75 amylose to amylopectin ratio which is a fairly good source of lipids (3–6%), in the form of polyunsaturated fatty acids (Sridhar and Lakshminarayana, 1994). Although millet is known to contain amylase inhibitors, the carbohydrate digestibility of millet foods is not affected because of heat-labile nature of the inhibitors (Chandrasekher *et al.*, 1981).

Millets are nutritionally superior to cereals, yet their utilization in the country is not widespread. They are mostly used in preparation of traditional dishes (Jayabhaye *et al.*, 2014). In recent years, millets have received attention, mainly because of their high fiber content and efforts are under way to provide it to consumers in convenient forms. One possible way of extending their utilization could be by blending them with whole wheat flour after suitable processing. On addition of Millet flour to whole wheat flour (maida) or other flours, there would be changes in physico-chemical, nutritional and functional characteristics (Vijayakumar *et al.*, 2009).

The objective of the present study was to develop extruded products with composite flour (Little millet flour , maida, Cow pea flour and soy flour) and to study the effect of composite flour on the physical properties: mass flow rate (MFR), density, moisture retention (MR), expansion ratio (ER), water absorption index (WAI), water solubility index (WSI), water holding capacity (WHC) of extrudates.

MATERIALS AND METHODS

Development of composite flour

Little millet flour was procured from market and sieved through 40 mm mesh sieve. Millet flour was mixed with branded maida, cow pea flour and soy flour procured from market in different combinations.

Blend preparation

Blends was prepared by mixing composite flour (little millet, maida, cow pea flour and soy flour) of different combinations with guar gum (1.25mg/g). Flour was moistened 25-30 % w.b and kneaded. Prepared dough was extruded through suitable die (3 mm diameter) and cut to have desired size of extrudate. Extrudate were steamed in steamer for 20 min at 100 ° - 105 °C

[1] Assistant Professor, [2] Senior Research Fellow
Agricultural Research Station,TNAU, Chetttinad

and distributed over trays for drying for 5 hours. Dried extrudate was packed in LDPE pack. Stored in ambient temperature 36 ± 2 ºC.

Table 1
Compositions of composite samples

Sample code	*Whole wheat flour (g)*	*Little millet flour (g)*	*Cowpea flour (g)*	*Soy bean flour (g)*
T1	20	60	10	10
T2	30	50	10	10
T3	40	40	10	10
T4	40	50	10	-
T5	40	50	-	10
T6	50	50	-	-
T7 (Control)	100	-	-	-

PHYSICAL PROPERTIES

Mass flow rate (MFR)

Mass flow rate was measured by collecting the extrudates for a specific period of time, as soon as it comes out of the die its weight taken instantly after its cooling to ambient temperature (Deshpande and poshadri, 2011).

$$MFR\,(gm/\sec) = \frac{Weight\ of\ sample\ collected\,(grams)}{Time\ taken\ to\ collect\ sample\,(Seconds)}$$

Density of extrudates

This indicates the overall expansion and the changes in cell structure, pores and voids developed in the extrudate as effect of processing as well as raw material parameters.

Tap density

The extrudates after grinding was filled in measuring cylinder of capacity 50 ml up to 20 ml and tapped 5-10 times. Weight of this 20ml of extrudates sample was taken (Deshpande and poshadri, 2011)..

$$Tap\ density = \frac{Volume\ of\ 20\,ml\ sample}{Volume\ of\ sample\,(20ml)}$$

Bulk density (BD)

$$Bulk\ density\,(g/cm^3) = \frac{Mass\ of\ extrudates}{Volume\ of\ extrudates}$$

Moisture retention (MR)

The moisture content (w.b) of the feed and extruded samples was determined by AOAC method (AOAC, 2005). Moisture retention (%) was calculated as

$$Moisture\ retention\,\% = \frac{Product\ moisture \times 100}{Feed\ moisture}$$

Expansion ratio (ER)

The ratio of diameter of extrudate and the diameter of die was used to express the expansion of extrudate (Fan *et al*., 1996). The diameter of extrudate was determined as the mean of 10 random measurements made with a Vernier caliper. The extrudate expansion ratio was calculated as

$$Expansion\ ratio = \frac{Extrudate\ Diameter}{Die\ Diameter}$$

Water absorption index (WAI) and Water solubility index (WSI)

WAI and WSI were determined by the method of Anderson, 1982. The extruded puffs were milled to a mean particle size of 200–250 μm. A 2.5 g sample was dispersed in 25 g distilled water, using a glass rod to break up any lumps and then stirred for 30 min. The dispersions were rinsed into tarred centrifuge tubes, made up to 32.5 g and then centrifuged at 4000 rpm for 15 min. The supernatant was decanted for determination of its solid content and sediment was weighed. WAI and WSI were calculated as

$$WAI = \frac{Weight\ of\ Sediments}{Weight\ of\ dry\ solids}$$

$$WSI = \frac{Weight\ of\ dissolved\ solids\ in\ supernatant \times 100}{Weight\ of\ dry\ solids}$$

Water holding capacity (WHC)

Approximately 5 grams of fine ground sample was weighed and allowed to rehydration over night in excess water (7:1) after draining, it was reweighed and calculated (Deshpande and poshadri, 2011).

$$WHC = \frac{Weight\ of\ wet\ extrudate\ powder - Weight\ of\ dry\ extrudate\ powder \times 100}{Weight\ of\ dry\ extrudate\ powder}$$

RESULTS AND DISCUSSION

Physical properties

The flour moisture level, feed rate, screw speed and die speed were kept constant throughout the experiments. The effects of composite flour on physical properties of extrudates are presented in Table 2.

Mass flow rate (MFR) was minimum for extruded sample T7 (1.90 ± 0.1) followed by sample T6 (1.91 ± 0.124) and T1 (1.92 ± 0.84). The variations in the mass flow rate of extrudate samples were very less, due to constant maintenance of barrel similar results were observed by Deshpande and poshadri, (2011). The bulk density (BD) of extrudates samples T2 and T3 (0.62 ± 0.05), the higher bulk density may be due to the presence of more crude fiber in the composite flour sample. Similar types of results were observed by Singh *et al*. (1996).

The water holding capacity (WHC) was maximum for extruded sample T7 (411.2 ± 0.05) than other sample. This could be due to higher level of cereal starch and crude fiber in the composite flour sample T7. Similar results were observed by Deshpande and poshadri (2011). The highest moisture retention (MR) was found in the extruded product prepared using composite flour sample T5 (35.82 ± 0.2) which may be due to the increase in protein content which was the result of maximum utilization of (soy flour) in the composite flour sample (Deshpande and poshadri, 2011).

The water solubility index (WSI) was more for the extrudates made from composite flour sample T7 (0.40 ± 0.04) followed by extruded sample T6 (0.36 ± 0) and WSI was less for the extrudates prepared from composite flour sample T2 (0.28 ± 0.08). The water solubility index of little millet flour and maida incorporated extrudates increased in 50:50 composite flour sample. The water absorption index (WAI) of the extrudates increased with decrease of chick pea and Cow pea flours in the composite flour. The water absorption index was found to be more for extruded sample T7 (3.24 ± 0.01) followed by extruded sample T6 (3.14 ± 0.03). Similar results were observed by Shirani and Ganeshranee (2009).

The result of expansion ratio (ER) of extrudates indicates that expansion ratio decreased with increased level of cereal starch and decreased amount of proteins in the composite flour T1 (1.01 ± 0.01). This decrease in expansion ratio could be because of high level of Little millet flour, which is rich in dietary fiber. Protein affects expansion through their ability to effect water distribution in the matrix and through their macro molecular structure and confirmation. The extruded sample T7 (1.56 ± 0.1) followed by T7 (1.56 ± 0.1) has more expansion ratio than other extruded sample. Similar findings were reported by Singh *et al.* (1996).

Table 2
Physical properties of extrudates

Treatments/ Samples	*Physical properties*							
	Mass flow rate (g/s)	*Tap density (g/cc)*	*BD (g/cm³)*	*WSI (%)*	*WHC*	*MR*	*ER*	*WAI (%)*
T 1	1.92 ± 0.08	0.75 ± 0.02	0.51 ± 0.06	0.31 ± 0.05	300.2 ± 0.04	33.75 ± 0.6	1.01 ± 0.01	2.95 ± 0.03
T 2	2.06 ± 0.06	0.76 ± 0.03	0.62 ± 0.05	0.28 ± 0.08	352.1 ± 0.03	33.90 ± 0.4	1.09 ± 0.09	2.87 ± 0.04
T 3	1.98 ± 0.05	0.75 ± 0.02	0.62 ± 0.06	0.30 ± 0.06	301.4 ± 0.02	31.06 ± 0.3	1.12 ± 0.12	2.92 ± 0.04
T 4	1.95 ± 0.02	0.73 ± 0	0.61 ± 0.04	0.35 ± 0.01	358.4 ± 0.05	32.80 ± 0.01	1.23 ± 0.23	3.01 ± 0.02
T 5	1.94 ± 0.04	0.75 ± 0	0.55 ± 0.02	0.35 ± 0.01	362.5 ± 0.02	35.82 ± 0.2	1.21 ± 0.21	3.11 ± 0.04
T 6	1.91 ± 0.12	0.73 ± 0.01	0.57 ± 0	0.36 ± 0	384.2 ± 0.07	35. 67 ± 0.4	1.45 ± 0.31	3.14 ± 0.03
T 7(Control)	1.90 ± 0.01	0.74 ± 0.03	0.55 ± 0.02	0.40 ± 0.04	411.2 ± 0.05	35.2 ± 0.03	1.56 ± 0.1	3.24 ± 0.01

SUMMARY AND CONCLUSION

From the present study, it was concluded that mass flow rate (MFR) was minimum for extruded sample T7 and T6 due to constant maintenance of barrel speed. The Water Solubility Index (WSI) of little millet flour and maida incorporated extrudates increased in 50:50 composite flour sample. Water Absorption Index (WAI) of the extrudates increased with decrease of chick pea and Cow pea flours in the composite flour. Expansion Ratio (ER) of extrudates indicates that expansion ratio decreased with increased level of cereal starch and decreased amount of proteins in the composite flour. Finally sample prepared from 50% maida and 50% little millet flour combination obtained similar score as that of control. Hence incorporation of millet flour and maida improved quality of extrudate in term of physical properties.

REFERENCES

Anderson, R.A. (1982), Water absorption and solubility and amylograph characteristics of roll-cooked small grain products. Cereal Chemistry 59: 265– 269.

Association of Official Analytical Chemists (AOAC). (2005), Official Methods of Analysis of the AOAC International. 18th edn. Gaithersburg, MD, USA.

Chandrasekher, G., Suryaprasad, R. D. and Pattabiraman, T. N. (1981), Natural plant enzyme inhibitors, a-Amylase inhibitors in millets. Journal of the Science of Food and Agriculture 32: 9–16.

Deshpande H. W. and Poshadri, A. (2011), Physical and sensory characteristics of extruded snacks prepared from Foxtail millet based composite flours. International Food Research Journal 18: 751-756

Fan, J., Mitchell J. R. and Blanchard, J. M. V. (1996), The effect of sugars on the extrusion of maize grits: The role of the glass transition in determining product density and shape. *International Journal of Food Science and Technology* 31: 55–65.

Jaybhaye. R. V, Pardeshi. I. L, Vengaiah. P. C and Srivastav. P. P. (2014), Processing and Technology for Millet Based Food Products: A Review. *Journal of Ready To Eat Food* 1(2): 32-48.

Shirani Gamalth and Ravindran Ganesharanee. (2009), Extruded products with fenugreek (*Trigonellagraecium*) Chick pea and Rice: physical properties, sensory acceptability and glycemic index. *Journal of Food Engineering* 90: 45-52

Singh, N., Singh, B., Sandhu, K. S., Bawa, A.S. and Sekhon, K. S. (1996), Extrusion behaviour of wheat, rice and potato blends. *Journal of Food Science and Technology* 33 (4): 291-294.

Sridhar, R. and Lakshminarayana, G. (1994), Contents of total lipids and lipid classes and composition of fatty acids in small millets: foxtail (*Setaria italica*), Proso (*Panicum miliaceum*) and Finger millet (*Eleusine coracana*). Cereal Chemistry 71: 355–359.

Vijayakumar. P. T. and Mohankumar. J. B. (2009), Formulation and characterization of *Millet* flour blend incorporated composite flour. *International Journal of Agriculture Sciences* 1(2): 46-54.

Vijayakumar. P. T , Mohankumar.J. B. and Srinivasan.T. (2010), Quality evaluation of noodles from millet flour blend incorporated composite flour. *Journal of Scientific & Industrial Research* 69: 48-54.