Plant Archives Vol. 20, Supplement 2, 2020 pp. 1718-1721 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

DEVELOPMENT AND EVALUATION OF PROTEIN RICH EXTRUDED PUFFED PRODUCT USING CORN, RICE, AND SOY PROTEIN ISOLATE (SPI) FLOUR

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Abstract

The objective of this study development of protein rich extruded puff product were prepared from corn flour (CF), rice flour (RF) and soy protein isolate (SPI) flour blends using with twin screw extruder and evaluation of physicochemical and sensory of the product. Present study was evaluating the quality of extruded product supplemented with different quantities of soy protein isolate (SPI). In the present study four samples (C, C1, C2 and C3) of extruded puff product were prepared by using SPI flour at different proportion. Each sample was prepared by 500 gm of flours blend. Samples C was prepared as control sample containing (CF: RF: SPI = 60:40:00 %), C1 (CF: RF: SPI = 57.5:37.5:05 %), C2 (CF: RF: SPI = 55:35:10 %) and C3 (CF: RF: SPI = 52.5:32.5:15 %), on the basis of all evaluations C2 sample was found to be better on the basis of physiochemical, sensory and nutritional properties, resulted extruded puffed product can be used as a nutritious food with higher content of protein with other nutritious elements its increased market of extruded product where quality protein is an issue.

Keyword **:** Extruded puff product, Soy Protein Isolate, Sensory, Extruder.

Introduction

Extrusion technology has been used in many industries that produce new and unique snack foods due to advances in this technology compared to other traditional methods. Extrusion is a high temperature short-time process which involves simultaneous thermal and pressure treatment along with mechanical shearing, resulting in changes such as gelatinization of starch, denaturation of protein, and at times complete cooking of the extrudates to obtain ready-to-eat products. Many extruded products are mostly made from cereals such as corn, rice and wheat. These cereals are rich in carbohydrates and fibers but relatively low in protein content, thus they need to enhance the protein component in the extruded products. Due to consumer demand for healthy extruded snack foods, many industries have increased focus in research and product development to produce products that are nutrient dense. Protein rich extruded products helps to improve the protein value of the tef based products which are consumed (Forsido *et al.*, 2011). Extrusion processing variables of soy protein isolate content, feed moisture content and processing temperature significantly influenced the physical properties of the extrudates (Ramaswamy *et al.*, 2012). Extrusion of corn soy blends, using a formulation that included corn meal, with soy flakes, concentrate and oil can provide a nutritious "instant" product. The product was free of trypsin inhibitor and provided a high available lysine (Konstance *et al.*, 1998). The effect of independent variables (yam flour level, barrel temperature and feed moisture content) on the response variables (ER, WAI, WSI and Hardness) of extrudates developed from yam-rice-corn flour blend formulation (Seth *et al.*, 2013). Defatted soy with whole soybean and to overcome the problems of extruding oily feed material, and barrel temperature had a profound effect on the texturized soy protein functionality since lower feed moisture content led to a better functionality and screw speed changed water absorption capability to a lower extent (Tehrani *et al.*, 2017). Increasing SPI content from 20 to 80% did not influence the ratio of these chemical linkages in meat analog but the expansion was greater (Tongta *et al.*, 2008). The feed moisture content, extrusion temperature, screw speed and gluten content were selected as the influencing factors; the texturized degree, water absorption, and hardness were selected as the response value (Min Wu *et al.*, 2018). The addition of SPI and WG proteins resulted in increased total pore volume compared to starch extrudates without protein (Ghorpade *et al.*, 2018). Inclusion of fructan provided improved desirable sensory/ organoleptic characteristics to the limited palatability of wholegrain snacks (Handa *et al.*, 2014). The cereal based extruded products can be fortified with seaweeds to increase nutritional and functional qualities as seaweeds exemplified therapeutic properties (Singh *et al.*, 2017). The products with high expansion ratio and low density and hardness, which are generally good characteristics of an extruded snack, were obtained at low feed moisture, high screw speed and medium barrel temperature within the range of our process variables (Sharma *et al.*, 2017).

Material and Method

Corn (*Zia maize*), Rice (*Oryza sativa*) and Soy protein isolate (SPI) were procured from local market of Jhansi.

Physicochemical and chemical compositions of raw material

Physicochemical properties and chemical composition of raw materials were evaluated to approve methods described by association of official analytical chemist (AOAC) for the analysis of the quality of raw materials that's procured local market.

Extrusion Process- For development of the extrudates, BTPL lab model twin screw extruder (Basic technology Pvt. Ltd. Kolkata Model No-002-13-14) was used. An extrusion process was conducted with different proportions of corn flour, rice flour and soy protein isolate. The extruder conditions were 1st heater temperature 60°C, 2nd heater temperature set on 110^0C First put moist feed with 25% moisture and optimum extrusion speed 350 rpm. The input feed rate was set at 15 rpm. The cutter (with flour blades) speed was set to 150 rpm, than prepare extruded product using with different parameter.

Steps of sample preparation

Four sample were prepared one as control (C) containing corn flour 350& rice 150, samples two (C1) contain corn 287.5 gm, rice 185.5 and SPI 25.0, sample three (C2) contain corn 275.0, rice 175.0 and SPI 50, sample fourth (C3) contain corn 262.5, rice 162.5, and SPI 75.0. Each sample mixed properly with 3.5gm salt and 40 ml water than mesh size sieve to improve mixing.

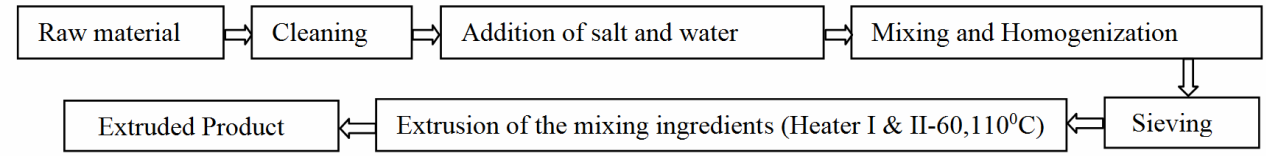

Table 1 : The prepared samples in different proportion of SPI (gm).

S. No.	Blend name	Corn flour (gm)	Rice flour (gm)	SPI flour (gm)
1.	C	350.0	150.0	-
2.	C1	287.5	185.5	**25.0**
3.	C2	275.0	175.0	**50.0**
4.	C3	262.5	162.5	**75.0**

Fig. 1 : Extruded puff products, (C=Control, C1=5%, C2=10%, C3=15% SPI blended samples

Result and Discussion

Physicochemical and chemical composition of raw material was evaluated according to standard internationally approved methods described by association of official analytical chemists (AOAC) for the assessment of the physicochemical and chemical quality of different flours.

Table 2 : Nutritional composition of different raw blends

Sample	Constituents				
	Carbohydrate (%)	**Protein (%)**	**Fat (%)**	**Ash (%)**	**Moisture (%)**
C	70.25	09.12	02.34	02.17	11.22
C1	71.01	13.65	02.56	01.18	09.42
C2	72.99	15.23	02.60	01.45	08.09
C3	74.01	20.07	03.05	01.12	07.13

(C=Control, C1=5%, C2=10%, C3=15% sample)

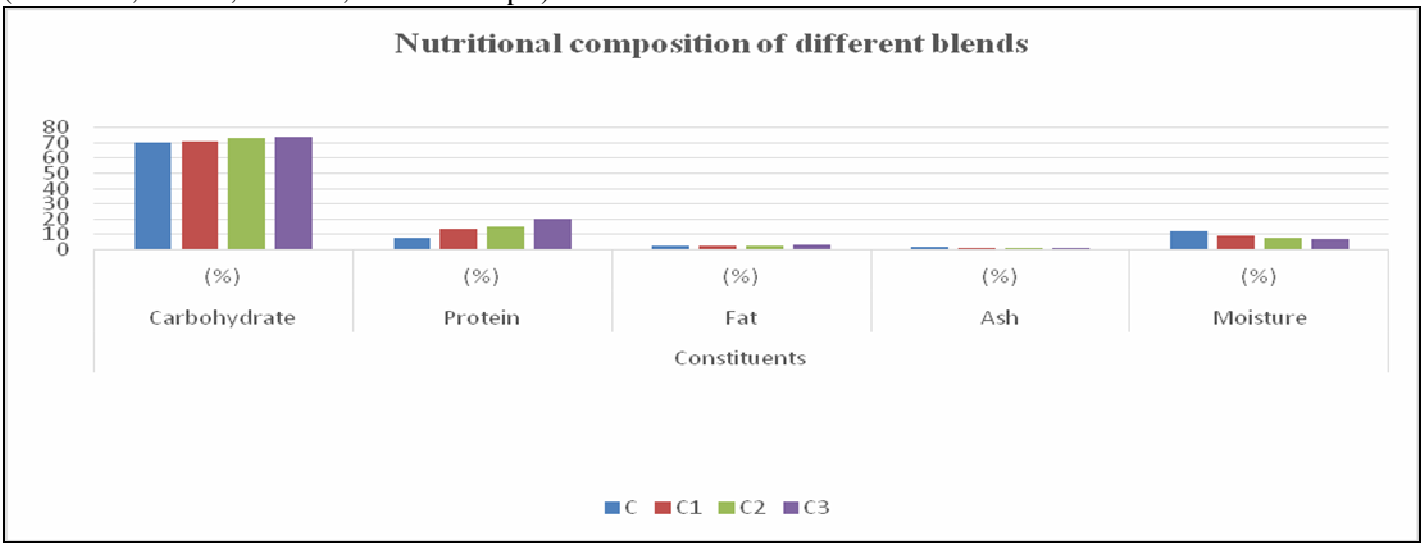

Fig. 2 : Graphical representation of Nutritional compositions of different blends

Table 3 : Nutritional composition of extruded puff

Sample	Constituents				
	Carbohydrate (%)	Protein (%)	Fat (%)	Ash (%)	Moisture (%)
C	76.25	07.15	01.65	03.11	10.42
C1	73.01	13.65	01.80	02.17	07.42
C2	**73.29**	**18.27**	**01.44**	**02.24**	**06.09**
C3	70.51	21.03	02.66	02.16	05.13
Mean value	73.51	14.27	01.91	02.43	07.21
SD±	02.27	00.44	07.46	00.24	05.52
SE ±	01.02	00.19	00.36	00.11	02.47

(C=Control, C1=5%, C2=10%, C3=15% sample, SD= Standard deviation, SE= Standard Error)

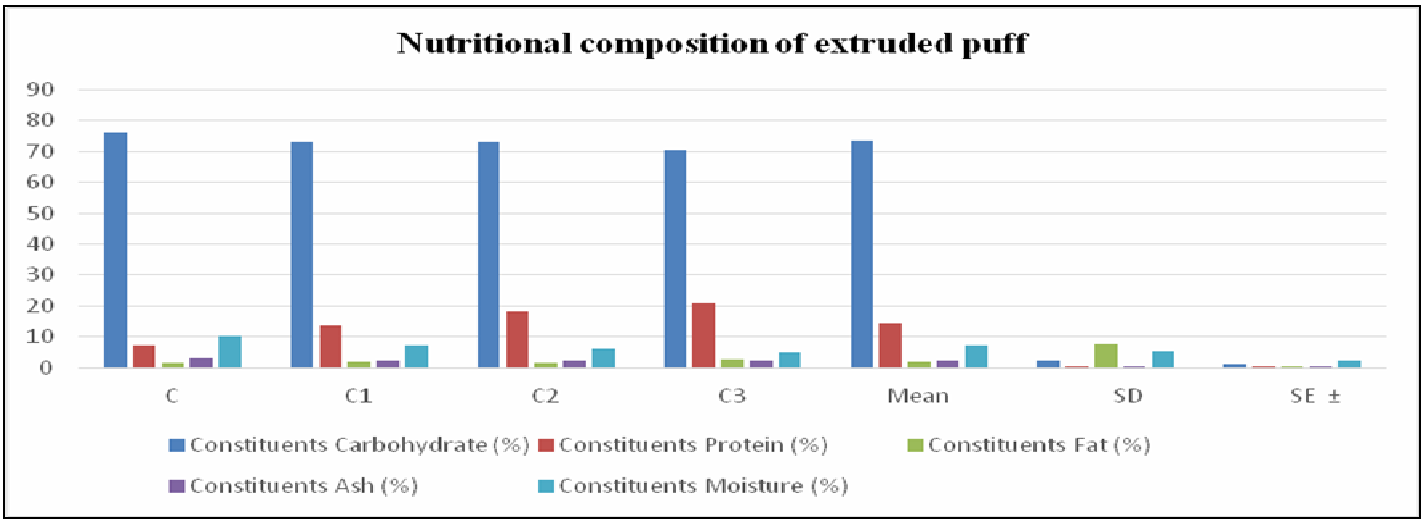

Fig. 3 : Graphical representation of Nutritional compositions of extruded puff

Sensory characteristics of extruded puff products

Sensory evaluation was carried out as per 9 hedonic scales. Among the five extruded puff products (C, C1, C2, C3) the fourth product (C2) had highest overall acceptability comparison to control sample. Overall acceptability of the product C3 indicated the desirable sensory properties which suitably reflected is acceptability. It is shown in tables high acceptability of C2 sample is improved taste and texture**.**

Table 4 : Sensory evaluation of extruded puff

Sample	Sensory property				Overall acceptability
	Color	Flavor	Texture	Taste	
C	7.95	7.85	8.1	8.0	7.07
C1	7.7	7.65	7.11	7.75	7.55
C2	**7.90**	**8.76**	**8.15**	**8.15**	**8.24**
C3	7.25	7.30	7.16	7.9	7.19

(C=Control, C1=5%, C2=10%, C3=15% sample)

Table 5 : Statistical analysis of sensory properties

(ANOVA) Sensory Analysis						
		Sum of Squares	df	Mean Square	F	Sig.
Color	Between Groups	4.467	3	1.156	1.157	0.34
	Within Groups	45.969	36	0.999		
	Total	50.436	39			
Flavor	Between Groups	5.969	3	2.323	1.788	0.167
	Within Groups	46.775	36	1.299		
	Total	52.744	39			
Texture	Between Groups	2.037	3	0.346	0.235	0.871
	Within Groups	42.838	36	1.468		
	Total	46.874	39			
Taste	Between Groups	15.806	3	5.269	3.687	0.021
	Within Groups	51.438	36	1.429		
	Total	67.244	39			
Overall Acceptability	Between Groups	1.116	3	0.372	0.412	0.745
	Within Groups	22.506	36	0.903		
	Total	23.622	39			

*Note- ($P \leq 0.05$) is considered a non-significant value (n=10).

Conclusion

Protein rich extruded puff product obtained in this study was made from combination of CF: RF: SPI flours using a twin-screw extruder. SPI improve textural properties, soy protein isolate were well distribution in starch, resulting in the increasing firmness and tensile strength. In this demonstration extruded puffed product prepared from blends of corn flour, rice flour and 10% SPI (C2) was found most acceptable for consumers and an excellent source of complete protein and it was also found that expansion ratio and bulk density were improved after SPI incorporation. Hence, if protein dense products are desired, such studies should be extended to higher protein level to assess their influence on the physical and sensory properties of the extruded products. These types of extruded puff products can be used as nutritional food for low income group in developing countries and for health conscious people.

Acknowledgement

The authors are thankful to the Bundelkhand University Jhansi, Uttar Pradesh, India for providing the necessary research facilities for the successful completion of research work

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