Evaluation of nutritional and sensory quality of functional extruded paneer produced from soy flour blended with reconstituted skim milk paneer

ABSTRACT

A study was conducted to prepare functional extruded paneer by using of soy flour with reconstituted skim milk which could be used as prorein and iron rich extruded food. The research evaluated nutritional and sensory quality of the function extruded paneer with the level of soy flour 5, 10 and 15 % respectively. The study had shows better sensory score of 10 % soy flour blended reconstituted skim milk with the respect of flavor, body & texture and overall acceptability. The other treated sample (control, 5 and 15 %) were found lesser sensory score compare to 10 % treated samplee. The functional characteristics such as Water Solubility Index (WSI), Water Absorption Index (WAI) and Oil Absorption Index (OAI) were significantly influence by the soy flour in the treated samples. The WSI and WAI significantly increases but OAI was decreases with significantly. The nutritional composition highest found it T_3 sample with moisture (5.97 %), fat (17.79 %), protein (45.86 %), minerals (2.96 %), fibre (2.21 %) and iron (1.84 mg/100gm) but the carbohydrates content was recorded highest in control sample with 28.81 % and lesser in T_3 sample (25.21 %). The developed product could be replace the another breakfast cereals based product and it is ready to eat food so there is no time are required for preparation. The function extruded paneer had excellent source of energy with respect to fat, protein, fibre and iron. The increasing of soy flour blending in sample the nutriotional characteristic was increases and it can be helpful for the children, pregnant womens and people suffereing from the anemia disease. It could to reduce the deficiency of the anemia among the people.

Keywords: Soy flour, extruded paneer, sensory and nutritional charactertics

INTRODUCTION

One of the main obstacles to the worldwide is shortage of food due to the growing population, which makes it more challenging to ensure that nutrition requirements can be satisfied in a way that is economical, healthful, and sustainable. Food extrusion is the technique of forcing food ingredients through a die, or aperture, that is intended to form and/or expand the material, through a number of treatments, such as kneading, melting, and/or shearing. One of the main benefits of extrusion cooking is its ability to produce a wide variety of extruded products from low-cost raw materials with short processing periods (Offiah *et al.,* 2018). This technology, known as "extrusion-cooking," has widespread application in the agri-food processing sector. It is a popular unit operation for making a wide range of food items, including those composed of starch, protein, lipids, water, and additives, all of which require different processing conditions (Navale*et al.,* 2015). A wide range of items are included in the category of extruded food, including breakfast cereals, cookies, almonds, and cereal-based snacks that provide nutritional fibre (Varsha and Mohan, 2016). Among legumes and cereals, soybeans have the highest protein content at almost 40 % (dry basis), making them one of the best plant sources of protein (Mazumder and Hongsprabhas, 2016). All of the essential amino acids required for optimal health are present in soy proteins. About four times the protein of wheat and six times the protein of rice grains, soybeans are also high in calcium, phosphorus, and vitamins A, B, C, and D (Taghdir*et al.,* 2017). Paneer (fresh cheese) is a traditional Indian acid-coagulated dairy product and carry a lot of market potential. It can be used in raw form or used in the preparation of several varieties of culinary dishes and fried snacks (Badola*et al.,* 2018). A significant proportion of the population in India is vegetarian. For vegetarians, paneer serves as a "meat substitute." For those who are vegetarians it is a good source of high-quality animal protein (Chaudhary *et al.,* 2019). Skimmed milk powder, also known as fat loose dried milk, is the milk powder produced

by using evaporating the water from the skimmed or 0.5 % fats milk with the aid of warmness remedy. It's miles a creamy excellent powder to experience, white in shade. Skimmed milk powder carries nearly the same amount of proteins (26 %) and carbohydrates (37 %) as within the liquid form on dry foundation (Abdalla*et al.,* 2017). The main objective of the present study is to evaluate the nutritional and sensory characteristics of functioanl extruded paneer which prepared from the different ingredient such as soy flour, refined wheat flour, pectin and skim milk powder.

MATERIALS AND METHODS

The purchased of Nandini brand skim milk powder from KMF stores in Bengaluru. The supplier of pectin was Silvateam in Bengaluru. Soy flour was procured from Arena Organica, Sikar. Good quality refined wheat flour was procured from More Retail Limited, Mumbai.

PREPARATION OF FUNCTIONAL EXTRUDED PANEER FROM SOY FLOUR BLENDED WITH RECONSTITUTED SKIM MILK PANEER

The reconstituted skim milk was prepared as per outlined by Khan *et al.* (2012) with slightly modification in the ratio of skim milk powder and water (1:7) followed by heating to 90 °C without holding then cooled to 60 °C for coagulation separately and mixed with 1 per cent citric acid solution as coagulating agent. The coagulum thus obtained was left undisturbed for approximately 5 min. Whey had drained through a fine muslin cloth and collect the paneer. The soy flour (5, 10 and 15 %) was blended with prepared reconstituted skim milk paneer to make a dough. The dough was extruded by using single screw extruder and followed by frying (110 °C).

PREPARATION OF CONTROL SAMPLE

The control sample was prepared by using 7.5 per cent refined wheat flour and 0.3 per cent pectin blended with reconstituted skim milk paneer and then make a dough. The prepared dough was passed through a single screw extruder for extrusion and followed by frying by

using sunflower oil at 110 °C.

SENSORY CHARACTERISTICS

Semi-trained judges have evaluated the functional extruded paneer's sensory qualities on a 9-point hedonic scale on frequently. Before being distributed to the judges for sensory evaluation, the evaluation samples were properly coded. In the sensory assessment lab, the samples are evaluated sensory. Panelists were requested to evaluate the sample according to the following sensory characteristics: body & texture, flavor, color and appearance, and overall acceptability.

FUNCTIONAL CHARACTERISTICS

The methodology described by Yagci and Gogus (2008) was followed in order to determine the Water Solubility Index (WSI) and the Water Absorption Index (WAI). The Oil Absorption Index (OAI) was determined using a procedure as Aditi and Arivuchudar (2018) provide.

NUTRITIONAL CHARACTERISTICS

The sample's moisture content was measured using ISI: SP 18 (Part XI) 1981. The sample's fat content was evaluated using the ether extract method in accordance with ISI: SP 18 (Part XI) 1981 protocol. The Microkjeldhal method was used to estimate the protein content in accordance with the guidelines provided in ISI: SP 18 (Part XI) 1981. The fiber content of samples was estimated using the procedure described in AOAC (1990). Iron content of sample was estimated as perthiocyanate method using spectrophotometric analysis describe by Bhuvaneswari *et al.* (2015). The difference approach was used to determine the amount of carbohydrates. It can be computed by deducting from 100 the total of the moisture, fat, protein, fibre and iron values (per 100 g).

RESULTS

EFFECT OF BLENDING DIFFERENT LEVELS OF SOY FLOUR ON SENSORY CHARACTERISTICS OF FUNCTIONAL EXTRUDED PANEER

The Control sample was denoted as T_0 conatins 7.5 % refined wheat flour and pectin blended with reconstituted skim milk powder. The T_1 sample was prepared by blending soy flour at 5.0 % level. The T_2 sample was prepared by blending soy flour at 10.0 % level and T_3 sample was prepared by blending soy flour at 15.0 % level

From table 1 the color and appearance scores award for control was lowest (7.69) and highest for the sample at 15 per cent level of soy flour (7.95). Among the all treatments, as the per cent incorporation of soy flour increased; the color and appearance score was also increased. However, statistical analysis says that there was a no significant difference at ($P \leq 0.05$) level. The flavor score of control 7.43 against 7.91, 7.99 and 6.91 out of 9.0 point hedonic scale with respect to T_1, T_2 and T_3 respectively as seen in table 1. The significant increase in the soy flour non significant increase in the flavor score up to 10 per cent afterward it was decreases significantly. Statistical analysis says that there was a significant difference between control, 5, 10 per cent and 15 per cent level treatment of soy flour. The body and texture score for control, T_1, T_2 and T_3 were 7.49, 7.96, 8.45 and 7.07. It was observed from table 1 there was significantly increasing of body and texture score up to 10 per cent added soy flour in the product. Further it was decreased in the body and texture score. Statistical analysis revealed that there was a significant difference between control and T_2 treatment and also with T_3 at ($P \leq 0.05$) level. The T_3 sample secured lowest overall acceptability scores (7.11) and highest score was recorded by T_2 (8.33). From (Table 1) it showed that as the soy flour levels increases the overall acceptability scores was significantly increased up to 10. Statistically, significant difference was noticed between control and treatments T_2 as well as with T_3 sample with respect to its overall acceptability at ($P \leq 0.05$) level.

Table 1: Effect of blending different levels of soy flour on sensory characteristics of functional extruded paneer

Treatments	Sensory characteristics

	Color and appearance	Flavor	Body and texture	Overall acceptability
T_0	7.69	7.43^{a}	7.49^{a}	7.47^{a}
T_1	7.75	7.91^{a}	7.96^{ab}	7.94^{ab}
T_2	7.82	7.99^{a}	8.45^{b}	8.33^{b}
T_3	7.95	6.91^{b}	7.07^{c}	7.11^{a}
CD (P≤0.05)	NS	0.49	0.51	0.55

Note:

All values are average of three trails

Similar superscripts indicate non-significant (NS) at corresponding critical difference (CD)

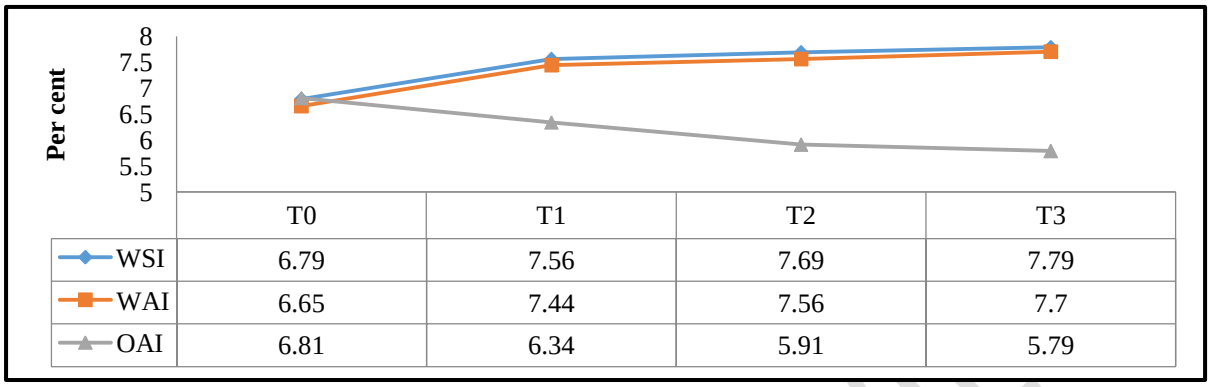
EFFECT OF BLENDING DIFFERENT LEVELS OF SOY FLOUR ON FUNCTIONAL CHARACTERISTICS OF FUNCTIONAL EXTRUDED PANEER

The highest WSI (7.79 per cent) was recorded in 15 per cent soy flour sample. Among the treated sample control sample was lowest WSI (6.79 per cent). The significant increase in the WSI with significant increase in the soy flour levels as seen in fig. 1.. Statistical analysis revealed that there was a significant difference between control and treatment T_1, T_2 and T_3 samples. From fig. 1the WAI recorded for control was 6.65 per cent followed by 7.44, 7.56 and 7.70 per centfor T_1, T_2 and T_3. The highest WAI recorded by 15 per cent soy flour added extruded paneer. Statistical significant difference was noticed between control and treatment T_1, T_2 and T_3 samples at (P≤0.05) level. The OAI of control sample, 5, 10 and 15 per cent soy flour added product were 6.81, 6.34, 5.91 and 5.79 per centrespectively. The OAI of control sample was significantly higher to T_2 and T_3. Statistical analysis revealed there was a significant difference between control and treated sample as well as within treatments at (P≤0.05) level as per fig. 1.

EFFECT OF BLENDING DIFFERENT LEVELS OF SOY FLOUR ON NUTRITIONAL CHARACTERISTICS OF FUNCTIONAL EXTRUDED PANEER

The highest moisture per cent (6.85 per cent) was recorded by control sample. The moisture per cent was recorded as 6.85, 6.76, 6.27 and 5.97 per cent by control, T_1, T_2 and T_3 treatments respectively. From (Table 2) showed there was a significant difference between control and treatments as well as within treatments at ($P \leq 0.05$) level. The fat content of control sample had 17.26 per cent followed by 16.81, 17.37 and 17.79 per cent at 5, 10 and 15 per cent of soy flour added extruded paneer. Statistically, significant difference was noticed between control and treatments T_1 and T_3 in Table 2. The protein per cent highest was recorded in 15 per cent of soy flour (45.86 per cent) and lowest was recorded by control sample (44.84 per cent) as recorded in table 2. The protein per cent were 44.84, 44.88, 45.30 and 45.86 per cent for control, T_1, T_2 and T_3 treatments respectively. Statistical analysis noticed there was a significant difference between control and treatments T_2 and T_3 and also found significant different to T_1. Increased in minerals content with increased the level of soy flour was noticed, the data recorded to minerals content were 2.03, 2.78, 2.89 and 2.96 per cent for control, 5, 10 and 15 per cent level of soy flour respectively. There was a significant difference between control andtreatments T_1, T_2 and T_3at ($P \leq 0.05$) level. The fibre content with respect to control, T_1, T_2 and T_3 were 0.21, 1.04, 1.68 and 2.21 per cent respectively as seen in table 2. However, statistical analysis says there was a significant difference between control andtreatments as well as within treatments at ($P \leq 0.05$) level. **F**rom table 2 the highest iron content was recorded by T_3 treated sample (1.84 mg/100g). The iron content were 0.0, 1.51, 1.67 and 1.84 mg/100g for control, T_1, T_2 and T_3. Significant difference was noticed between control and treatments at ($P \leq 0.05$) level. The carbohydrates content was decreased with increasing the soy flour level in functional extruded paneer as noticeable in table 2. The carbohydrates content for control sample, 5, 10 and 15 per cent soy flour added product were

28.81, 27.73, 26.49 and 25.21 per cent respectively. Statistical analysis reveals there was a significant difference between control and treatments as well as within treatments T_1, T_2 and T_3 samples at ($P \leq 0.05$) level.



	T0	T1	T2	T3
WSI	6.79	7.56	7.69	7.79
WAI	6.65	7.44	7.56	7.7
OAI	6.81	6.34	5.91	5.79

Figure 1: Effect of blending different levels of soy flour on functional characteristics of functional extruded paneer

Table 2: Effect of blending different levels of soy flour on nutritional characteristics of functional extruded paneer

Treatments	Moisture	Fat	Protein	Minerals	Fibre	Iron (mg/100g)	Carbohydrates
	Per cent						
T_0	6.85^{a}	17.26^{a}	44.84^{a}	2.03^{a}	0.21^{a}	0.0^{a}	28.81^{a}
T_1	6.76^{a}	16.81^{b}	44.88^{a}	2.78^{b}	1.04^{b}	1.51^{b}	27.73^{b}
T_2	6.27^{bc}	17.37^{a}	45.30^{b}	2.89^{b}	1.68^{b}	1.67^{b}	26.49^{c}
T_3	5.97^{c}	17.79^{c}	45.86^{c}	2.96^{b}	2.21^{c}	1.84^{b}	25.21^{d}
CD ($P \leq 0.05$)	0.49	0.39	0.41	0.43	0.43	0.42	0.47

Note:

All values are average of three trails

Similar superscripts indicate non-significant (NS) at corresponding critical difference (CD)

DISCUSION

EFFECT OF BLENDING DIFFERENT LEVELS OF SOY FLOUR ON SENSORY CHARACTERISTICS OF FUNCTIONAL EXTRUDED PANEER

The color and appearance score of 7.95 secured by T_3 sample was non-significant ($P \leq 0.05$)higher than control (7.69), T_1 (7.75) and T_2 (7.82). The slightly increasing in color and appearance could be due to denaturation of protein during frying which responsible to light brownish color of extruded paneer. Also reflects the suitability of raw material used for the preparation and provides information about the formulation and quality of the product. Patil *et al.,* (2014) found 32 per cent soy flour content cookies was significantly higher score in color and appearance (8.13). The sample T_2 had 7.99 flavor score was significantly ($P \leq 0.05$)higher than T_3 sample (6.91). The significant decrease in flavor score with increasing the soy flour level at 15 per cent could be due to the beany flavor of soy. Similar finding was obtained by Odiase *et al.,* (2013) found 10 per cent soy flour based meat ball was significantly highest score. The body and texture score for T_2 (8.45) was significantly higher than control (7.49) and T_3 (7.07). The (Table 2) showed that addition of soy flour up to 10 per cent level the product was develop crunchy with good body and textural characteristics but hard texture was noticed with increased the level of soy flour (15 per cent). Odiase *et al.* (2013) found 10 and 15 per cent of soy flour was more acceptable in meatballs. Similar observation reported by (Aleem *et al.,* 2012). From the results it was noticed that the overall acceptability scores increase significantly till 10 per cent of soy flour addition in extruded paneer, afterwards it was decreased significantly ($P \leq 0.05$)could be due to hard body and beany flavor in the extruded paneer. SimilarlyBiji*et al.* (2013) reported significant increasing in overall acceptability score rice based traditional product (pedia). Similar results was observed by (Kadirvel and Puraikalan, 2015).

EFFECT OF BLENDING DIFFERENT LEVELS OF SOY FLOUR ON FUNCTIONAL CHARACTERISTICS OF FUNCTIONAL EXTRUDED PANEER

The T_3 sample (7.79 per cent) recorded significantly ($P \leq 0.05$) higher WSI to control sample (6.79 per cent), whereas; T_1 (7.56 per cent) and T_2 (7.69 per cent) found non significant to T_3. It was observed that significant increasing of WSI as the increasing soy flour level could be due to significant increasing in protein content of extruded paneer blended with soy flour. Similarly Tadesse *et al.* (2019) reported the WSI value of extruded food were 7.51, 7.90 and 8.62 per cent. Similar data was observed by (Olusegun *et al.,* 2016). The WAI of control sample (6.65 per cent) was found significantly ($P \leq 0.05$) lower to other treatments T_1 (7.44 per cent), T_2 (7.56 per cent) and T_3 (7.70 per cent). The significant increasing of WAI in treated sample due to presence of hydrophillic group in soy flour which was responsible to increasing. Sudha *et al.* (2010) reported WAI in instant vermicelli prepared with soy flour at 5, 10 and 15 per cent were 38.6, 40.0 and 42.0 per cent. Similar trends was observed by (Mashayekh*et al.,* 2008; Ochelle*et al.,* 2018; Mohajan*et al.,* 2018 and Tadesse *et al.,* 2019). The significantly ($P \leq 0.05$)decreasing of OAI with increasing the soy flour level with respect to control sample might be due to presence of non-polar amino acids in soy protein which could be helps in less absorption of oil by extruded food. Otegbayo*et al.* (2013) reported significant decreasing of OAI in the range of 2.15 to 1.66 per centwith increasing levels of soy flour. Similar data was found by (Alpaslan and Hayta, 2006; Sudha *et al.,* 2010).

EFFECT OF BLENDING DIFFERENT LEVELS OF SOY FLOUR ON NUTRITIONAL CHARACTERISTICS OF FUNCTIONAL EXTRUDED PANEER

It was observed that moisture content of control sample (6.85 per cent) was significantly ($P \leq 0.05$) higher than treatments T_2 (6.27 per cent) and T_3 (5.97 per cent). The significant decreasing of moisture content as the significant increasing of soy flour might be due to the fact that soy flour contain higher amount of total solids with high emulsifying properties compared to other flours. Similar finding was reported by (Banureka and Mahendran, 2011; Olatidoye and Sobowale, 2011; Farzana and Mohajan, 2015 and Taghdir*et al.,* 2017). The T_3

had 17.79 per cent of fat content was significantly (P≤0.05) higher than control (17.26 per cent) and treatments T_1 (16.81 per cent) and T_2 (17.37 per cent). Figures shows significant increase in fat content with increasing the level of soy flour could be due to soy flour itself contains 19 per cent fat and also increasing of fat might be due to the holding of extra fat which has been used during frying. Similar findings were observed by (Singh *et al.,* 2011 and Ostermann-Porcel *et al.,* 2017). The protein content of T_3 sample (45.86 per cent) was significantly (P≤0.05)higher than control sample (44.84 per cent) and treatments T_1 (44.88 per cent) andT_2 (45.30 per cent). The significant increasing of protein content with addition of soy flour in the extruded paneer could be due to higher amount of protein (36 per cent) present in soy flour. The protein content of the yoghurt sample produced from 100 per cent milk was 2.98 per cent as compare to 4.79, 6.03, 6.68 and 9.14 per cent for the yoghurt samples produced from 10, 20, 30 and 40 per cent whole soybean flour, respectively (Ityotagher and Julius, 2020). Similar results was reported by (Alabi and Anuonye. 2007). It can be seen from the results that T_3 sample had significantly higher value of minerals (2.96 per cent), fibre (2.21 per cent), iron (1.84 mg/100g) contents compare to control samples. The significant increasing of minerals, fibre and iron content with respect to soy flour added in products could be due to soy flour has been good source of iron content (0.16 per cent). Similar findings with respect to minerals, fibre and iron was observed by (Ndife*et al.,* 2011; Ayo *et al.,* 2014 and Haque *et al.,* 2020). The carbohydrates content was significantly (P≤0.05)decreased as increasing the levels of soy flour. The control sample (28.81 per cent) was found significantly higher to other treated sample T_1 (27.73 per cent),T_2 (26.49 per cent) and T_3 (25.21 per cent). The variations in carbohydrate content of extruded paneer may result from the difference in the level of fat, protein, minerals, fibre and moisture content of soy flours. Similar trend was reported by (Islam *et al.,* 2007 and Awasthi *et al.,* 2012).

CONCLUSION

Blending of soy flour with reconstituted skim milk paneer at different level (0, 5, 10 and 15 %) affected the functional, nutritional and sensory quality with significantly. Increases in soy flour the WAI and WSI were increases but OAI was decreases. The nutritional charactertics of functional extruded paneer increases with respect to increasing of soy flour while carbohydrates was decreased. The study was observed that sensory score of the functional extruded paneer increases up to 10 % of soy flour but futher addition of soy flour at 15 % the sensory score decrease significantly. It can conclude that sensory score indicate highly acceptable of functional extruded paneer at 10 per eent level of soy flour.

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