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Functional and chemical profile of extruded, reconstituted skim milk paneer using refined wheat flour and pectin

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Abstract
An attempt has been done to develop reconstituted skim milk paneer based extruded by using various combination of refined wheat flour and pectin. The combination were 5.0 & 0.4, 7.5 & 0.3, 10.0 & 0.2 and 12.5 & 0.1 percent levels of refined wheat flour and pectin. Among various combination, the 7.5 and 0.3 percent combination found significantly higher overall acceptability score with 7.47; whereas 12.5 and 0.1 percent combination was found lowest overall acceptability score of 6.33. The moisture (7.07%), fat (19.33%) and protein (51.34%) contents was recorded in control sample but in 12.5 and 0.1 percent level of combination found moisture (6.44%), fat (16.34%) and protein (42.90%) contents. The functional characteristics was found significant impact on all treated sample with refined wheat flour and pectin. The developed extruded was positive effect on sensory, nutritional as well as functional characteristics due to functional properties of refined wheat flour and pectin which gain popularity among the people.

Keywords: Extruded, functional, sensory, nutritional, refined wheat flour and pectin

Introduction
Human beings have an innate experience of attachment to natural things therefore, it should not be surprising that most people, in latest decades, have a robust desire for natural food. Function of food as an agent for improving health has proposed a new class of food, with effective effects on host fitness and/or well-being beyond their dietary value. Milk and dairy products are associated with fitness blessings for decades with having beneficial nutritional composition (Roman *et al.,* 2017; Eertmans *et al.,* 2005) [18, 8]. India ranks first in worldwide milk production with 198.2 million tonnes (BAHS, 2020-21) [6], at growth rate of 6.62 percent per year. Paneer is smooth cheese, popular in Indian subcontinent; it's far obtained through heat and acid coagulation of milk at better temperature and unique coagulants are used is lactic acid, citric acid, bitter milk and tartaric acid (Khan *et al.,* 2012; Kumar *et al.,* 2014) [13, 15]. Extrusion cooking is a widely used method for making extruded food, which are often made from flour or starches. Extruded foods are frequently rich in calories and fat, poor in protein and fibre (Korkerd *et al.,* 2016) [14]. Refined wheat flour has a low protein content due to the bleaching process and its exposure to heat during milling. It mainly incorporates carbohydrates. Alternatively, all-purpose flour is a form of flour that is made from a aggregate of smooth and tough wheat. It does no longer comprise brought leavening agent which is why it's also called "plain flour" in some areas. It is able to be bleached or unbleached. It has a protein content of 10-13% (Chandra *et al.,* 2015) [7]. Pectin is regularly gaining recognition as a food emulsifier. currently, several studies have centered on revealing the factors that have an impact on pectin's emulsifying and emulsion-stabilizing residences. Aside from the complicated molecular shape of the polyanion, the intrinsic characteristics of various systems, which includes polymer concentration, ionic power, and pH, make contributions to making emulsification the usage of pectin very difficult (Siew *et al.,* 2008) [19].

Materials and Methods
Preparation of extruded reconstituted skim milk paneer using refined wheat flour and pectin
Refined wheat flour and Pectin were blended in the combination of 5.0 & 0.4, 7.5 & 0.3, 10.0 & 0.2 and 12.5 & 0.1 percent levels by weight of paneer to prepare the dough. The dough is passed through single screw extruder. After extrusion it was frying by sunflower oil to obtained ready to eat extrudate type food.

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Sensory characteristics
The sensory characteristics of extruded paneer has been evaluate at regular intervals by semi trained judges on a 9-point hedonic scale. The samples for evaluation was coded appropriately before serving the samples to the judges for sensory evaluation. Sensory evaluation of the samples is carried out in the sensory evaluation lab. The panelists are requested to grade the sample on the basis of sensory attributes: colour and appearance, flavour, body & texture and overall acceptability.

Functional characteristics
Water Solubility Index (WSI) and Water Absorption Index (WAI) were determinedas per the method outlinedby (Yagci and Gogus, 2008) [22]. Oil Absorption Index (OAI) was determined as per the method describe by (Aditi and Arivuchudar 2018) [3].

Nutritional characteristics
Moisture content of the sample was estimated as per (ISI: SP 18 Part XI, 1981) [10].Fat content of the sample was estimated by ether extract method as per procedure of ISI: SP 18 (Part XI) 1981. The protein content of sample was determined by Microkjeldhal method as per procedure given in (ISI: SP 18 Part XI, 1981) [10].Carbohydrates content was determined by the difference method. It can be calculated by subtracting the sum of the values (per 100 g) for moisture, fat and protein from 100.

Results and Discussion
Effect of blending different combination of refined wheat flour and pectin on sensory characteristics of extruded
The color and appearance and flavor score increased non-significantly ($p \leq 0.05$) with increasing the refined wheat flour level up to 7.5 percent and decreasing of pectin level up to 0.3 percent. The T_2 sample (7.69) was recorded non significantly higher than control (7.60), T_1 (7.61), T_3 (7.65) and T_4 (7.66) for color and appearance score. Similar result was recorded in the flavor score T_2 sample had 7.43 was non significantly higher than control (7.38), T_1 (7.40), T_3 (7.41) and T_4 (7.40). Similarly result was obtained by Harinivenugopal (2018) [9] found 50:50 combination of corn and wheat flour respectively secure highest flavor (8.25) score compared to other three treatments with 25:75, 75:25 and 100:00.
As per the result, when the levels of refined wheat flour increased from 5 to 7.5 percent and pectin decreased from 0.4 to 0.3 percent there was a significant ($p \leq 0.05$) improvement in the body and texture and overall acceptability scores. Further increasing in refined wheat flour and decreasing in pectin levels lead to decreased sensory scores. The overall acceptability of T_2 sample (7.47) was significantly higher than control (7.21), T_1 (7.26), T_3 (7.00) and T_4 (6.33). The panelists found that product prepared from 7.5 and 0.3 percent of refined wheat flour and pectin was found more acceptable. The increased levels of refined wheat flour above 7.5 and decreased in pectin level of 0.3 percent becomes more puffiness and weak brittleness could be the reason. Similar finding was observed by Thejaswini and Rao (2014) [21] had

obtained 50:50 combination of wheat and rice flour best and secure highest body and texture score (8.33) compared to other two treatments with 60:40 and 70:30 respectively. Similarly data was reported in cookies by (Amir *et al.,* 2015 and Jan *et al.,* 2018) [5, 11].

Table 1: Effect of blending different combination of refined wheat flour and pectin on sensory characteristics of extruded

Treatments	Sensory characteristics			
	Color and appearance	Flavor	Body and texture	Overall acceptability
T_0	7.60	7.38	7.25[a]	7.21[a]
T_1	7.61	7.40	7.28[a]	7.26[a]
T_2	7.69	7.43	7.49[b]	7.47[b]
T_3	7.65	7.41	7.01[c]	7.00[c]
T_4	7.66	7.40	6.31[d]	6.33[d]
CD ($p \leq 0.05$)	NS	NS	0.17	0.11

Note:
All values are average of three trials
T_0= Control
T_1= Product was prepared by blending refined wheat flour and pectin at 5.0 and 0.4% level
T_2= Product was prepared by blending refined wheat flour and pectin at 7.5 and 0.3% level
T_3= Product was prepared by blending refined wheat flour and pectin at 10.0 and 0.2% level
T_4= Product was prepared by blending refined wheat flour and pectin at 12.5 and 0.1% level

Effect of blending different combination of refined wheat flour and pectin on functional characteristics of extruded
The WSI of control sample (6.65 percent) was significantly ($p \leq 0.05$) higher than T_2 (5.97 percent), T_3 (5.72 percent)and T_4 (5.44 percent). It was observed that there was significantly decreasing of WSI with the increasing level of refined wheat flour and decreasing level of pectin. A high value of WSI is not desirable from nutritional point of view as it indicates fast digestion process and intestinal absorption (Altan *et al.,* 2009) [4]. Sisay *et al.* (2018) [20] reported significantly decreasing of WSI might be due to once protein denature it will become insoluble and lead to reduction of WSI value.
It was observed that WAI of control sample was significantly ($p \leq 0.05$) higher (6.31 percent) compared to T_3 (5.64 percent) and T_4 (5.37 percent) this could be to significantly reduction of protein content which are responsible for water absorption of the products. Similar data was reported by Kumari *et al.,* (2018) [16] prepared snacks by using hulled and hull-less barley; WSI was obtained in the range of 3.10 to 4.91 g/100g. Similar results was obseved by (Chandra *et al.,* 2015) [7].
The OAI of T_4 sample (7.52 percent) was found non significantly ($p \leq 0.05$) higher than control sample (7.33 percent) and other treatments T_1 (7.39 percent), T_2 (7.41 percent) and T_3 (7.45 percent). It was observed that there was a non-significantly increasing in OAI as the increasing the level of refined wheat flour and decreasing the level of pectin. Noorakmar *et al.* (2012) [17] reported higher the sweet potato flour level higher the absorption of oil due to the greater the expansion the higher the surface area which trapped more oil by the air cells of the product.
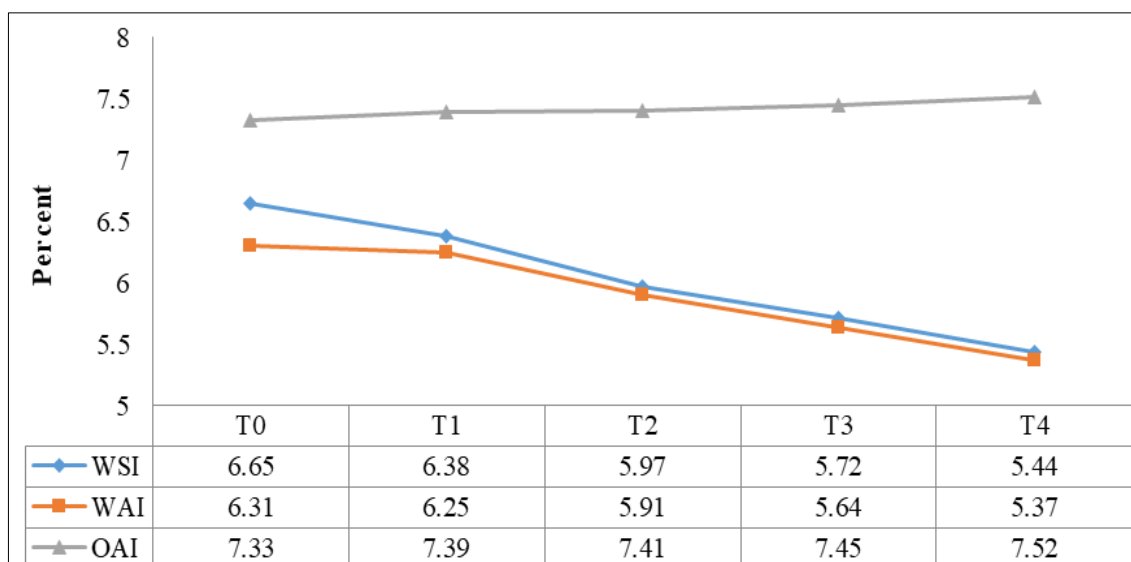
Fig 1: Effect of blending different combination of refined wheat flour and pectin on physico-chemical characteristics of extruded paneer

Effect of blending different combination of refined wheat flour and pectin on nutritional characteristics of extruded

The moisture content of control and T_4 was showed to be statistically significant ($p \leq 0.05$). This could be mainly due to different composition of raw ingredients used in the preparation of extruded paneer. The fat content of control sample (19.33 percent) was found significantly higher to T_1 (17.79 percent), T_2 (17.26 percent), T_3 (16.77 percent) and T_4 (16.34 percent) and also between treated samples. Table (8) showed significantly decreasing in fat content with increasing the level of refined wheat flour and decreasing of pectin could be due to refined wheat flour itself contains less fat than fat percent in paneer. Similar pattern was recorded by protein content; the control sample (51.34 percent) was significantly higher than other treatments T_1 (46.90 percent), T_2 (44.84 percent), T_3 (44.09 percent) and T_4 (42.90 percent) and

between treated samples also found significant difference. The significant ($p \leq 0.05$) reduction of protein percent may be due to lower percent of protein in refined wheat flour than in paneer. There was significantly ($p \leq 0.05$) increase in carbohydrate content with increasing refined wheat flour and decreasing pectin levels. The T_4 sample (32.63 percent) showed significantly higher carbohydrates than the control (19.50) and other treated samples T_1 (26.02 percent), T_2 (29.01 percent), T_3 (30.60 percent). Adebanjo et al. (2020) [2] reported moisture content in the range of 3.54 to 4.59 percent in extruded flakes prepared by maize and carrot flour. Thejaswini and Rao (2014) [21] found significantly decreasing of fat content (9.82 to 8.13 percent) with increasing the wheat flour in cereals based extruded products. Our data is matched with Katke et al. (2018) [12] and Abioye et al. (2018) [1] with respect to moisture, fat, protein and carbohydrates.

Table 2: Effect of blending different combination of refined wheat flour and pectin on physico-chemical characteristics of extruded paneer

Treatments	Moisture	Fat	Protein	Carbohydrates
	Percent			
T_0	7.07^a	19.33^a	51.34^a	19.50^a
T_1	7.03^a	17.79^b	46.90^b	26.02^b
T_2	6.85^a	17.26^{bc}	44.84^c	29.01^c
T_3	6.67^a	16.77^{bc}	44.09^c	30.60^d
T_4	6.44^b	16.34^c	42.90^d	32.63^e
CD ($p \leq 0.05$)	0.49	1.42	0.99	1.40

Note:
All values are average of three trials
T_0=Control
T_1= Product was prepared by blending refined wheat flour and pectin at 5.0 and 0.4% level
T_2= Product was prepared by blending refined wheat flour and pectin at 7.5 and 0.3% level
T_3= Product was prepared by blending refined wheat flour and pectin at 10.0 and 0.2% level
T_4= Product was prepared by blending refined wheat flour and pectin at 12.5 and 0.1% level

Conclusion

The study was revealed effectively that extruded *paneer* was prepared with reduced proportions of refined wheat flour and pectin in combinations. Both ingredients had significant impact on sensory, functional and nutritional characteristics of the product. But final identified combinations were 7.5 and 0.3 percent of refined wheat flour and pectin respectively was found to be optimum for good attributes of extradites with reduced refined wheat flour (maida).

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