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Development of extruded snack by using multigrain with pineapple pomace powder

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■ **ABSTRACT :** Interest in developing food with nutritionally functional ingredient has been driven by the market potential for food. That can improve the health and wellbeing of consumers. Extruded snack (chakli) is traditional savory product was known as deep fat fried product. As per the results, its fat content is high. The variable sample were prepared by incorporating with the chickpea (*Cicer arietinum* L.), maize (*Zea mays*), *Ragi* (*Eleusine coracana* L.), green gram (*Vigna radita*) flour's extrusion cooking was carried out a single screw (Hand molder) and the frying temperature is (180-200^{0}C) for the 15 minute's the extrudate nutritional or the physical properties namely bulk density, water absorption index (WAI), oil absorption capacity, texture analysis were also analyzed. The orgaoleptic evaluation of extruded snack (chakli) sample were analyzed by panel list on a 9 point hedonic scale the results show that the composite flour chickpea, maize, ragi, green gram, pineapple pomace powder flourin the ratios of 48:15:15:20:2, respectively could be used to produce quality extrudate snack (chakli) with acceptable sensory properties.

■ **KEY WORDS :** Chemical, Physical property, Extrusion, Multigrain flours, Pineapple pomace powder, Sensory evaluation, Texture analysis

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People now a day's love to consumed snack food because of the light and quick meal that can be consumed anywhere and anytime compared with the main meal. Besides by living in a very hectic lifestyle also lead many people to consume a snack food in a way to prevent them from hunger (Sarangam *et al*., 2015). Snack contributes an important role of daily nutrient and calorie intake for consumers. Cereals have been popular material for extrusion for food uses mainly because of functional quality. Low cost and ready to availability (Deshpande and Poshadri, 2011).

Chickpea (*Cicer arietinum* L.) is legume grows in tropical or subtropical regions, that present high potential as a functional ingredient for the food industries. The chickpea contain significantly high protein (17-22%), low fat (6.48%), high carbohydrate available (63%) and crude fibre content (3.82%) on dry basis (Saleh and Tarek, 2006) the mainly carbohydrate starch which is reported to be show digestible hence improve chickpea can play important role as low glycemic functional ingredient. Cereals have been popular raw materials for extrusion because of their functional properties, low cost and ready availability. Owing to high protein content, millets can be effectively utilized for enhancing the nutritional quality of cereal based extruded food (Manjula and Visvanathan, 2014).

Maize (*Zea mays*) is one of the staple food maize flour is widely used to prepare the extruded products. There is a need to improved nutritional quality of the product. The appropriate degree of maize replacement is needed to increase the nutritional contribution of extruded broken rice flour and finger millet flours because it helps to keep consumer acceptance high.

Ragi (*Eleusine coracana*) is occupies the largest area under cultivation among the small millets *Ragi* stands unique among the cereal; such as barley rye and oats with higher nutritional contents and has outstanding properties as a subsistence of food crop its rich in calcium (0.34%), dietary fibre (18%), protein (6-13%) and mineral (2.5%). It's also rich in thymine, riboflavin, iron and other essential acids. The presence of phytochemical is enhance the nutraceutical of potential finger millet also the power house of health benefitting nutrients (Chandra *et al*., 2016).

Green gram (*Vigna radita*) legume is cultivated on 3.08 million hectors. It's an important source of protein (22.51%). Green gram were evaluated of moisture content in the range of (8.39%) green gram is the most widely distributed species among the six Asiatic vigna species. It is one of the predominant source of protein and certain essential amino acid like lysine and tryptophan in vegetarian diet. It is possessed certain added feature compared to other pulses (Pandiyan *et al*., 2012).

Pineapple world production reached 21.8 million of tones in 2011 and most of its production is used for processing as fruits, salads, juices and jams during processing, large amounts of by products consisting mainly of peel and pomace are generated representing about 25-30 per cent. Since most of these by product have no specific destination. They may be inappropriately disposed causing environmental issues. Consequently it is of vital importance to reuse in industrial by products in order to improve the process economics and its sustainability. The current way of life which is required by limited free time and increased working hours has turned consumers to the consumption of ready-to-eat products (Kumar *et al*., 2014).

■ METHODOLOGY

Raw materials :

Chickpea flour, maize flour, *Ragi* flour, green gram flour, and pineapple pomace powder were purchased from local commercial market suppliers grinded separately in local market milling machine, Hot air oven, ultracentrifuge, weighing balance, hand molder (Single screw extrusion) and other equipments. Black pepper powder, cumin powder, chili powder, black salt and edible fortune oil.

Pineapple pomace powder preparation :

Pineapple washed in tap water and removes the waste material. Peel was removed with a plain stainless steel knife and trimming of the material also done. A juice mixer and grinder cum food processer was used to extract the pineapple juice. The remaining pomace was collected and blanched also. After blanching pomace was cooled and dried. A tray dryer was used for drying pineapple pomace. The sample was spread over the trays and the temperature of the dryer was set at 60ºC. The drying procedure continued till the moisture content of the sample was reduced to about 5±1% (wet basis). The grinding operation was performed using the food processer with the grinder attachment in department. The powder was grind to pass through the sieve of 2 mm size and pomace was stored in sealed polythene bag for further use.

Composite flour preparation :

The control product was prepared by using 100 per cent of the chickpea flour as per standard. In order to formulate the recipe of composite flour for preparation of extruded snack with enhanced nutritional quality. Different preliminary trial were carried out of followed by the sensorial evaluation of product to optimize the

Table A : Standardization of formulation of composite flour

Sr. No.	Flour	Composition of composite flour (%)			
		Control	Sample A	Sample B	Sample C
1.	Chickpea flour	100	49	48	47
2.	Maize flour	----	10	15	20
3.	Ragi flour	----	10	15	20
4.	Green gram flour	----	30	20	10
5.	Pineapple pomace powder	----	01	02	03

maximum suitable concentration of maize and *Ragi* flour incorporation. It was observed that if concentration of chickpea flour incorporation is reduced beyond 50 per cent then the overall quality of the prepared product is being drastically reduced as per product becoming brittle while the minimum concentration of green gram flour is required otherwise product becoming hard. Hence, the basis of preliminary trial following recipe get finalized (Sawant *et al*., 2013).

Method for preparation of extruded snack :

The production of extruded snack was started by dry mixing of the composite flour in a bowl. Then the spices is mixed with the flours and also the dry ingredient were added mixed throughly. The mixture was kneeded in the bowl and dough was formed with use of enough water added. Then the dough was placed in to the hand molder and before pressing on the butter paper oil must be heated to 180-200^{0}C and then fry the product 15 min until the product turns in golden brown colour.

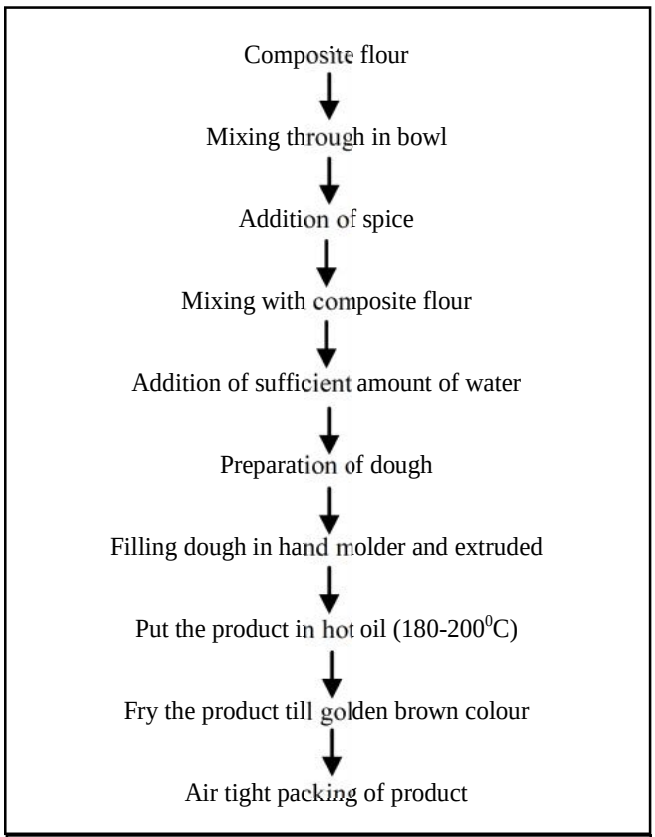

Fig. A : Flow chart for the prepared extruded snack

(1) Control sample (2) Sample A

(3) Sample B (4) Sample C

Fig. B: Prepared extruded snack sample

Chemicalanalysis of extruded snack :

Moisture content :

Moisture content of fig pulp and value added fig fruits was determined by using hot air oven method given by Ranganna (1995). The sample was heated in oven at 105±5^{0}C for six hour or till the constant weight was obtained. The loss in weight was calculated on per cent basis.

$$\% \text{ moisture} = \frac{\text{Initial weight - Final weight}}{\text{Weight of sample}} \times 100$$

Ash content :

The total ash content was determined by the method cited by Ranganna (1995). The sample was taken in a previously weighed silica crucible. The ash content was determined by ashing the sample at 525±5^{0}C for 6 hours in muffle furnace.

$$\% \text{ Ash content} = \frac{\text{Weight before ashing - Weight after ashing}}{\text{Weight of sample}} \times 100$$

Crude fibre :

The crude fibre content of fig fruits and other valued added products was determined by the method cited by Ranganna (1995). The crude fibre is an organic residue

remained after sample is digested with conc. acid and alkali.

Weighed amount of dried and fat free sample was taken and digested with 0.225 N (1.25 %) sulphuric acid and 0.313 N (1.25 %) sodium hydroxide alkali for 30 minutes each and then washed with water. The sample was neutralized with dilute acid and filtered through muslin cloth. The sample was then washed with alcohol and hot water and dried in a hot air oven with asbestos at 110^0C temperature till constant weight. The loss in a weight of sample was measured.

$$\% \text{ fibre content} = \frac{\text{Initial wt. - Loss in wt. of sample}}{\text{Initial wt. of sample}} \times 100$$

Protein :

For the digestion of samples the Pelican digestion unit was used. The distillation was carried out in Soxoplus. The protein content of the dried sample was estimated as per cent total nitrogen by the Micro-kjeldahl method and computed by multiplying the per cent nitrogen using conversion factor 6.25 (AOAC, 2005).

Estimation of fat :

Fat was estimated as crude ether extract of the dry material. The dry sample (5g) was weighed accurately into a thimble and plugged with cotton. The thimble was then placed in a soxhlet apparatus and extracted with anhydrous ether for about 3h. The ether was then evaporated and the flask with the residue dried in an oven at 80-100° C, cooled in a desiccator and take wait of sample (AOAC, 2005).

$$\% \text{ Crude fat} = \frac{\text{Weight of crude fat}}{\text{Weight of sample}} \times 100$$

Carbohydrate :

Total carbohydrate was determined by standard procedure using phenol and sulphuric acid AOAC (1990). Sample (500 mg) was taken in test tube in an ice bath; 2 ml of 72 per cent H_2SO_4 was added to avoid the burning of sample. Then the volume of solution was made to 23 ml with distilled water. The sample was refluxed in water bath at $90+5^0$C for 3 hr. it was then filtered through a Whatman No.1 filter paper and volume of the filtrate was made to 50 ml with distilled water. 1ml aliquot was taken for analysis; to this 2ml H_2SO_4 and 0.5 ml with distilled water. 1 ml aliquot was phenol was added. The standard curve was prepared using standard glucose solution corresponding to 0.2, 0.4, 0.6, 0.8 and 1 mg of glucose. The intensity of color was measured at 480 nm by spectrophotometers. From the standard curve, the concentration of total sugar was calculated (AOAC, 2005).

Physical parameter of extruded snack :

Bulk density :

As an average diameter and average length of 25 readings of extruded sample were known, its volume as computed by AOAC (2005).

$$\text{Bulk density} = \frac{\text{Mass of extruded}}{\text{Volume of extruded}}$$

Water absorption index (WAI) and water solubility index (*WSI*) :

WAI and WSI were determined by the method of AOAC (2005). The extruded puffs were milled to a mean particle size of 200-250 xm. 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 upto 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,

$$\text{WAI (\%)} = \frac{\text{Weight of residual}}{\text{Weight of sample}} \times 100$$

$$\text{WSI (\%)} = \frac{\text{Weight of supernatant}}{\text{Weight of sample}} \times 100$$

Texture parameter of extruded snack :

Texture was analysed by Texturometer. Extruded snack were subjected to a compression test by using fracture wedge probe attached to an Instron Universal Testing Machine of TAXT. Plus texture analyzer with 5 kg load cell. Pre test speed of 2.50 mm/sec, test speed 3.300 mm/sec and post test speed of 10.00 mm/sec were maintained. The force required to break the vermicelli was measured to indicate texture (hardness) in terms (Anton and Luciano, 2007).

■ RESULTS AND DISCUSSION

It can be clearly seen from Table 1 that the great variation exist in various constituents among the flours to be used in making the extruded snacks. Moisture content is one of the most important and commonly

Table 1 : Proximate composition of different ingredients used for extruded product preparation

Name	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Fibre (%)	Carbohydrate (%)
Chickpea flour	9.81	5.38	17.25	1.65	3.91	60.56
Maize flour	10.4	4.74	9.42	1.75	3.60	70.9
Ragi flour	13.1	1.5	3.6	1.5	3.25	69.05
Green gram flour	9.74	1.35	22.5	2.91	2.90	60.6
Pineapple pomace powder	7.40	2.40	0.52	1.89	29.26	58.53

measured properties of the food product. It is measured for number of reasons including legal and lable requirements, economic important, food quality better processing operation and storage stability considerations. It could be observed from the table that moisture per cent amongst all the ingredients, chickpea flour contains highest amount of fat *i.e.* 5.38 per cent while the lowest fat content was observed in *Ragi* flour *i.e.* 1.5 per cent. With respect to protein, the protein content of chickpea flour, maize flour, ragi flour and green gram flour was found to be 17.25 per cent, 9.42 per cent, 3.6 per cent, 22.5 per cent, respectively. The results pertaining to protein content revealed that incorporation of green gram flour may increase overall protein of extruded snack product highest value for ash was found in green gram flour while the *Ragi* flour was found to contain lowest ash per cent amongst the investigated ingredients. The fibre content of chickpea flour, maize flour, Ragi flour and green gram flour was found to be 3.91 per cent, 3.60 per cent, 3.25 per cent and 2.90 per cent, respectively.

The results with respect to the composition of chickpea flour are comparable with the earlier reported values (Hefnway and Ramadan, 2012) nearly similar values of *Ragi* flour (Chandra *et al.*, 2016) and maize flour were reported earlier.

Chemical parameters of extruded snack :

Chemical parameters includes protein content, ash content, fibre content, fat content and moisture content and carbohydrate. The results from Table 2 shows that moisture content of control sample was found lowest while increase in concentration of maize and *Ragi* flour linearly increased the moisture content of product. The carbohydrate content was drastically reduced from 68.2 per cent for control to 60.04 per cent for sample C. With respect to protein content, it could be clearly observed that protein content of sample increased from 12.91 per cent to 20.49 per cent in sample A. Then again goes low graph in sample B 18.15 per cent and in sample C 16.3 per cent which is significantly high justifying the suitability of maize, *Ragi* and green gram flour incorporation in the product. The values of crude fibre content almost tripled from control to sample C. Fat content of sample also increased from 6.1 per cent to 11.29 per cent. The increase in fat content is due to increased protein content which increased the absorption of fat in final product. In all it could be concluded that incorporation of maize and *Ragi* flourin extruded product resulted in increase in moisture, protein, fat, crude fibre and ash content. While decreased the carbohydrate content.

From Table 3, bulk density shows decreasing values with increasing concentration of maize and *Ragi* flour. The higher bulk density may be due to the presence of more crude fibre in the composite flour sample similar types of results were observed by Deshpande and Poshadri (2011).

The water solubility index of the product found the results as values are increased with increasing concentration flour of maize, *Ragi* and green gram flour water solubility index is a function of starch content of extruded product which shown in Table 3.

Table 2 : Chemical parameter of snack

Properties	Control	Sample A	Sample B	Sample C
Moisture (%)	6.51±0.2	6.57±0.2	6.61±0.3	6.69± 0.2
Ash (%)	1.02±0.1	1.42±0.6	1.72±0.2	2.01± 0.3
Fat (%)	6.01±0.4	8.01±0.3	8.70±0.4	11.29± 0.3
Protein (%)	12.91±0.2	20.49±0.1	18.15±0.1	16.3± 0.3
Crude fibre (%)	1.18±0.2	2.59±0.2	3.02±0.2	3.31± 0.1
Carbohydrate (%)	68.2±0.5	60.92±0.4	61.98±0.4	60.4±0.5

Table 3 : Physical parameter of extruded snack

Parameters	Control	Sample A	Sample B	Sample C
Bulk density	0.52 ± 0.1	0.52 ± 0.1	0.50 ± 0.2	0.51 ± 0.6
Water solubility index (WSI) %	0.28 ±0.2	0.31 ± 0.1	0.35 ± 0.2	0.36 ± 0.2
Oil absorption capacity (%)	4.28 ± 0.4	5.17 ± 0.3	5.32 ± 0.3	5.46±0.4

Table 4 : Determination of rupture force by CT3 texture analyzer

Sr. No.	Sample	Rupture force (kg)	Co-efficient of variation	Probe used
1.	Control sample	4.409±1.809	41.027	TA39
2.	Sample A	9.139±0.140	1.529	TA39
3.	Sample B	7.728±1.211	15.671	TA39
4.	Sample C	5.049±1.107	21.738	TA39

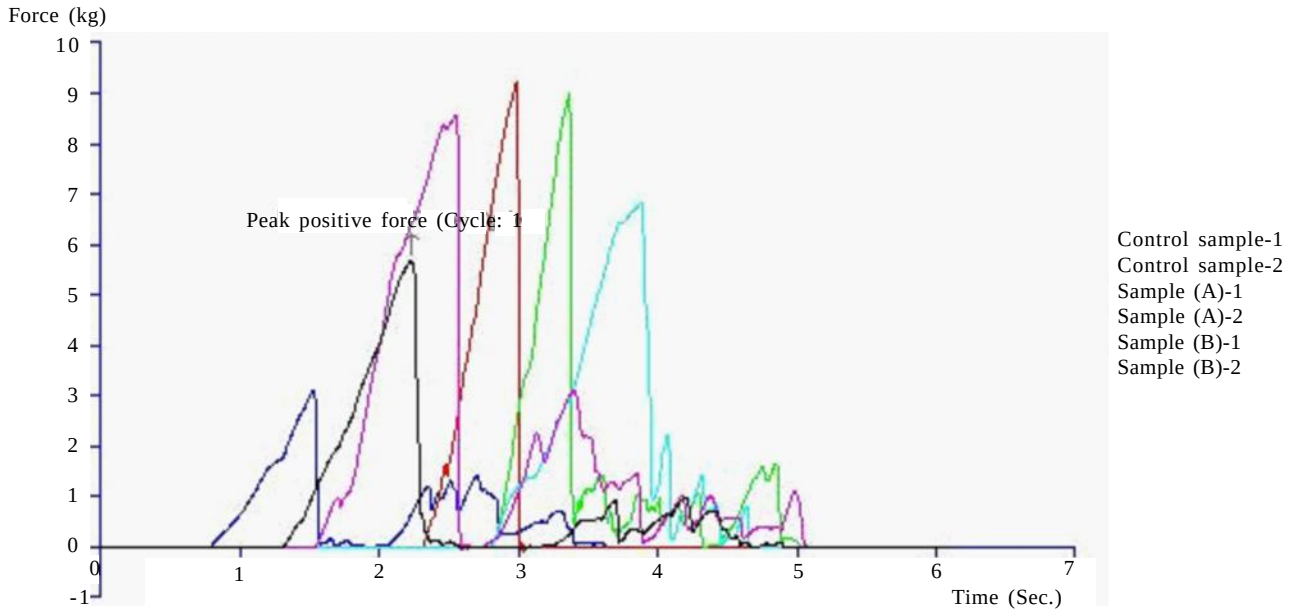

Fig. 1 : Textural parameters measurement of extruded snack TA_XT Texturometer (TPA)

Oil absorption capacity of product is found to increase with increasing concentration of maize and *Ragi* flour. The oil absorption capacity is the function of fibre content of product (Deshpande and Poshadri, 2011)

Table 4 shows the variation in Rupture force between control sample, sample A, sample B and sample C. Probe used for all the this sample is TA39. Co-efficient of variation of control sample, sample A, sample B and sample C is 41.02, 1.52, 15.67 and 21.73, respectively.

Conclusion :

Thus, in the light of the scientific data of the present investigation, it may be concluded that the extruded snacks prepared from the composite chickpea flour, maize flour, *Ragi* flour, green gram flour, pineapple pomace powder samples which were analyzed for their physico-chemical and sensory acceptability. The extruded sample B prepared from composite flour in the ratios of 48:15:15:20:02 was found to be more acceptable with respect to mentioned quality parameters. Further prepared extruded snack sample B packed in HDPE stored in ambient temperature and examined the effect of storage on sensorial quality and textural parameters in interval storage period time.

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both authors. Author Pranayjeet Shinde designed the study, performed the statistical analysis, managed the analyses of the study and wrote the manuscript. Author Surekha Dabhade managed the literature searches. Both authors read and approved the final manuscript.

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