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RESEARCHARTICLE

QUALITY CHARACTERISTICS OF BY-PRODUCTS INCORPORATED *PAPADS*

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ABSTRACT

Various types of by-products are produced during milling in the legume and cereal industries. In the present study, value-added *papads* were developed by incorporating by-products obtained after milling of bengal gram and rice. The developed *papads* were studied for their organoleptic characteristics, functional properties and shelf-life. Three types of *papads* namely control, Type-I and Type-IV *papads* were selected on the basis of organoleptic scores, which were prepared by utilizing bengal gram seed coat and bengal gram brokens alongwith broken rice. The by-products supplemented *papads* were observed to have lower values of diameter, oil absorption and diametrical expansion, when compared to control *papad*. During shelf-life study, no remarkable changes in organoleptic acceptability of developed *papads* were observed even after three months of storage.

INTRODUCTION

The shortage and sharp rise in prices of the conventional foodstuff have forced nutritionists to investigate alternative ones. By-products from food processing such as represent one such class of alternatives. These are often utilized as feed for animals or as fertilizers on farms. However, these by-products can be considered as promising sources of functional compounds (Laufenberg *et al.,* 2003). There is a rapidly growing body of literature covering the role of plant's secondary metabolites in food and their potential effects on human health. Furthermore, consumers are increasingly aware of diet related health problems, therefore demanding natural ingredients which are expected to be safe and health-promoting (Schieber*et al.,* 2001). Bengal gram is also called Chickpea or Gram (*Cicer arietinum* L.) in South Asia and Garbanzo bean in most of the developed world, is a major pulse crop in India. A large amount of by-products are produced during bengal gram processing in regions where this is a major food legume (Southern Europe, North Africa, India and Middle East countries) (Vania, 2010). These comprises of legume seed coat, powder, large and small brokens, shriveled and under-processed grains. Presently, these are disposed off only as feed grade material, fetching low remunerative prices (Ramakrishnaiah *et al.,* 2004).

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Broken rice is also a by-product of rice milling industry is mainly used as feed and as a brewing adjunct. Most of these by-products are rich in protein, calcium, iron, zinc and fibre, so these can be utilized for making health foods for different age groups (Yadav *et al.,* 2007). Blackgram (*Phaseolus mungo*) *papad* is widely consumed in India as an adjunct after frying or toasting. Preparation of blackgram *papad* comprises mixing of blackgram flour, sodium chloride and additives such as sodium carbonate and bicarbonate and water, making the dough, rolling the dough to circular shapes of approximately 10 cm diameter and slow drying to a final moisture content of 14-15%. Blackgram flour contains the mucilaginous principle, which provides a desirable consistency and rolling property to the dough (Shurpalekar and Venkatesh 1975).

However, *papad* can also be prepared using cereal or legume flours or a combination of both. Since it is made from pulses, it is easy to digest and nutritious as well. The product is free from gluten, rich in protein and dietary fibre. *Papads* are compulsorily served with food at hotels, restaurants, parties and sold in most of grocery shops and most of families consume it daily (Parpia, 2008). The market scenario describes blackgram dhal *papad* as the most dominating item and many industries are also developed. Formerly, *papad* making was a house hold occupation of women folk now days it has taken up as a cottage/small scale industry. In recent years, the uses of legume and cereal by-products gained importance as ingredients in the formulation of various food products. By keeping these facts in view, in the present study by-products

supplemented *papads* were prepared and evaluated for organoleptic characteristics, functional properties and shelf-life study.

MATERIALS AND METHODS

Procurement of materials

Three types of by-products were used in the present study namely bengal gram seed coat, bengal gram brokens (*Cicer arietinum* L.) and broken rice. All these were procured in a single lot from legume and cereal processingmills. Other ingredients for development of *papad* were procured from local market.

Processing of materials

Bengal gram seed coat, *bengal* gram brokens and broken rice are subjected to processing before use to remove dust, dirt and other unhygienic foreign materials. Raw *bengal* gram seed coats and bengal gram brokens were cleaned and washed under running water and dipped in rolling boiling water for 10 min. They were dried in hot air oven at 70°C for 6 h. Broken rice were also cleaned and washed under running tap water and dried at 60°C for 6 h. All the samples were milled to fine powder for further use.

Development and organoleptic characteristics of *papad*

The preparation method of *papads* is presented in Figure 1. Using different combination of raw material different types of *papads* were developed. All participants tasted control and six variation of *papad*. For each sample, participants were asked to score colour, appearance, flavour, texture, taste and overall acceptability on a nine-point Hedonic Scale (1=dislike extremely, 5=neither like nor dislike, 9 to like extremely).

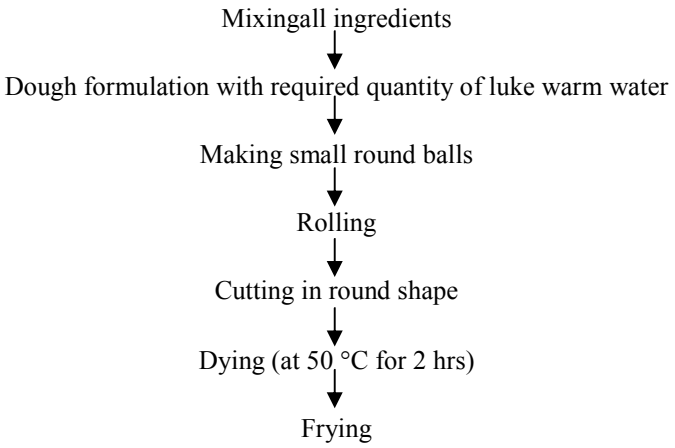

Fig. 1. The processing schedule for *papad* preparation

Between tasting different samples, participants rinsed their mouth with water. On the basis of organoleptic acceptability, from each category the *papad* exhibited higher scores of organoleptic characteristics were selected for further analysis.

Functional Properties

Diameter of raw and fried *papad*

The diameter of raw and fried *papad* of different compositions were measured on opposite ends with the help of thread and recorded.

Diametric Expansion

The expansion percentage of fried *papads was* calculated according to the procedure of Vidyavati *et al.* (2004). Diameter was calculated employing the following formula:

$$\text{Diametric expansion (\%)} = \frac{DF - DR}{DR} \times 100$$

Where,
DF = diameter of fried *papad*
DR = diameter of raw *papad*

Oil Uptake

The oil uptake by *papads* was calculated according to the method of Vidyavati *et al.* (2004). The absorbance of oil by the *papads* was calculated according to the formula:

Oil absorbed (%) = Oil quantity before frying – Oil quantity after frying × 100

Shelf-life study

For the shelf-life study the most acceptable *papads* were stored for 3 months in air tight plastic containers at room temperature. The *papads* were evaluated for sensory parameters like taste, appearance, aroma, texture, colour and overall acceptability using 9 point hedonic scale by a panel of ten judges at different intervals of 0, 15, 30, 45, 60, 75 and 90 days.

RESULTS

Organoleptic characteristics

The mean scores of organoleptic characteristics are given in Table 1. The Type-I and Type-IV *papad* scores were comparable to control *papad* in all organoleptic characteristics. The mean scores for organoleptic characteristics of Type-I and Type-IV *papad* were significantly higher than Type-III *papad* supplementation level. The reason for this might be the score of colour, which was lower because of more percentage of bengal gram seed coat which affected the color of *papad* adversely. Similarly, organoleptic characteristics mean scores of bengal gram brokens with broken rice flour *papad* for 20:20 and 30:30 per cent were significantly lower than 10:10 per cent supplementation level. In both types of by-products supplementation, the organoleptic characteristics scores decreased as the incorporation increased.

Functional properties

The functional propoerties of organoleptically accepted *papads* is presented in Table 2. In the present study, the mean initial diameter of control, Type-I and Type-IV *papads* was noticed as 5 cm. After frying, the increase in diameter was higher for control *papad* (6.72 cm) followed by Type-IV *papad* (6.12 cm) and Type-I *papad* (5.90 cm). About diametrical expansion, higher reduction was noted in Type-I *papad*. The mean diametrical expansion values of *papads* examined to be 34.47 per cent for control, 18.00 per cent for Type-I and 22.40 per cent for Type-IV *papads*. The values of oil uptake were significantly different for the three

Table 1. Mean scores of organoleptic characteristics of *papad*

Level of supplementation	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Control (BGF::100%)	8.15±0.13	8.17±0.12	7.55±0.13	7.77±0.24	7.55±0.12	7.84±0.14
BGF:BGSC:BR						
Type-I (85:5:10)	7.70±0.19	7.58±0.12	7.45±0.19	7.49±0.11	7.70±0.14	7.58±0.25
Type-II (70:10:20)	7.60±0.23	7.55±0.16	7.52±0.27	7.57±0.15	7.82±0.13	7.61±0.25
Type-III (55:15:30)	6.50±0.12	7.22±0.14	7.30±0.22	7.55±0.13	7.40±0.29	7.19±0.27
BGF:BGB:BR						
Type-IV (80:10:10)	7.70±0.15	7.37±0.02	6.80±0.14	7.70±0.13	7.67±0.14	7.45±0.17
Type-V (60:20:20)	7.55±0.12	7.15±0.13	6.68±0.12	7.63±0.11	7.55±0.18	7.31±0.18
Type-VI (40:30:30)	7.37±0.11	7.10±0.10	6.63±0.14	7.45±0.12	7.40±0.19	7.19±0.15

Values are mean±SE of ten independent observations
Control (BGF 100%) Type-I (BGF:BGSC:BR 70:10:20) Type-II (BGF:BGB:BR 80:10:10)
BGF= Black gram flour. BGSC= Bengal gram seed coat. BGB= Bengal gram brokens. BR= Broken rice.

Table 2. Functional properties of *papad*

Types of *papad*	Diameter (cm)			Diametrical expansion (%)	Oil uptake (%)
	Initial	Final	Difference		
Control	5	6.72□0.01	1.72□0.07	34.47□6.24	15.91□0.07
Type-I	5	5.90□0.06	0.90□0.03	18.00□3.12	14.11□0.03
Type-IV	5	6.12□0.01	1.12□0.05	22.40□4.23	15.14□0.04

Values are mean ± SE of three independent determinations
Control (BGF 100%) Type-I (BGF:BGSC:BR 70:10:20) Type-II (BGF:BGB:BR 80:10:10)
BGF= Black gram flour. BGSC= Bengal gram seed coat. BGB= Bengal gram brokens. BR= Broken rice.

Table 3. Shelf-life study of *papad*

Parameter	Storage period	Control	Type-I	Type-IV
Colour	0 days	8.15±0.03	7.60±0.01	7.70±0.05
	30 days	7.98±0.24	7.53±0.17	7.68±0.17
	60 days	7.88±0.24	7.48±0.15	7.48±0.15
	90 days	7.80±0.13	7.33±0.14	7.42±0.09
Appearance	0 days	8.17±0.01	7.55±0.02	7.37±0.03
	30 days	7.93±0.25	7.45±0.18	7.27±0.08
	60 days	7.90±0.03	7.25±0.16	7.22±0.07
	90 days	7.83±0.07	7.18±0.10	7.17±0.03
Aroma	0 days	7.55±0.05	7.52±0.03	6.80±0.03
	30 days	7.50±0.02	7.47±0.25	6.72±0.03
	60 days	7.42±0.02	7.40±0.22	6.62±0.12
	90 days	7.40±0.09	7.27±0.12	6.57±0.07
Texture	0 days	7.77±0.03	7.57±0.03	7.70±0.03
	30 days	7.68±0.13	7.42±0.13	7.58±0.01
	60 days	7.50±0.13	7.30±0.13	7.50±0.10
	90 days	7.43±0.06	7.22±0.04	7.43±0.04
Taste	0 days	7.55±0.06	7.82±0.13	7.67±0.13
	30 days	7.45±0.28	7.74±0.44	7.58±0.07
	60 days	7.35±0.27	7.68±0.44	7.47±0.15
	90 days	7.32±0.12	7.57±0.21	7.47±0.15
Overall acceptability	0 days	7.84±0.14	7.61±0.25	7.45±0.17
	30 days	7.71±0.17	7.52±0.05	7.37±0.18
	60 days	7.61±0.14	7.42±0.08	7.26±0.15
	90 days	7.45±0.16	7.31±0.13	7.21±0.16

Values are mean±SE of ten independent observations
Control (BGF 100%) Type-I (BGF:BGSC:BR 70:10:20) Type-II (BGF:BGB:BR 80:10:10)
BGF= Black gram flour. BGSC= Bengal gram seed coat. BGB= Bengal gram brokens. BR= Broken rice.

types of *papads* prepared. Maximum amount of oil uptake was observed in control *papads* (15.91 %) followed by Type-IV *papads* (15.14 %) and Type-I *papads* (14.11%).

Shelf-life study

The effects of storage time on organoleptic characteristics of control and by-products supplemented *papad* are shown in Table 3. For the shelf life of the three most acceptable *papads* was stored for a period of 3 months at ambient conditions (room temperature). No remarkable changes in the organoleptic characteristics viz. colour, appearance, aroma, texture and taste were observed upto 3 months of all the three types of *papad* stored. However, overall acceptability scores of control, Type-I and Type-II *papad* declined during storage from 7.84, 7.61 and 7.45 at zero days to 7.45, 7.31 and 7.21 at 90th days of storage but, the decline was non-significant. The result indicated that all the three products were shelf stable upto 3 months of storage.

DISCUSSION

The results of the present study reveal that it is possible to prepare dehydrated products such as *papad* by incorporating by-products of *bengal* gram and rice milling industry. Overall organoleptic characteristics of *papads* like colour, appearance, taste, aroma and overall acceptability were comparable to control in both fresh and stored products. However, as the substitution level of by-products increased the organoleptic acceptability decreased. The score of functional properties resulted from the replacement of black gram flour with by-products was found to be quite lower than that of control *papad*. The initial diameter of control and by-products incorporated *papads* was same. But, difference in diameter after frying was more profound in Type-I *papad* as compared to other control and Type-IV *papad*. Similarly, as compared to control *papad*, lower diametrical expansion and oil absorption was achieved by *papads* supplemented with *bengal* gram seed coat and bengal gram brokens alongwith broken rice.

Conclusion

From the results of the study carried out, it can be concluded that it is possible to prepare *papad* using by-products of milled

bengal gram (*Cicer arietinum* L.) and broken rice as the products were acceptable even after three months of storage. This value addition will provide these by-products an economical importance also. Hence, these by-products of milled *bengal* gram can be commercially exploited further for human consumption.

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