

QUALITY CHARACTERISTICS AND SHELF LIFE STUDY OF READY TO FRY DEHYDRATED POTATO SNACK PREMIX

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ABSTRACT : A technique for development of ready-to-fry dehydrated potato snack premix incorporating potato flour, rice flour and various spices was standardized. The prepared dehydrated potato snack premix was packed in LDPE bags and stored at room temperature for a period of 6 months to study the shelf-life and quality attributes of the prepared product. The physicochemical parameters including ash content, protein content, Free fatty acids and peroxide value of dehydrated premix remained unaffected during storage up to six months with the exception of moisture which increased significantly ($p < 0.05$) during storage. Slight but significant ($p < 0.05$) reductions in bioactive components including total phenolics and total antioxidant activity of dehydrated snack premix occurred during storage. The ready to eat fried potato snack prepared from dehydrated premix was found to be highly acceptable for up to 6 months of storage without any change in sensory quality.

Keywords : Potato, potato flour, premix, total phenolics, antioxidants.

Potato production has significantly increased in recent years in India, making it to the position of second largest potato producing country in the world. Despite the increasing production, bulk of the crop incurs heavy post harvest losses due to its perishable nature and inadequate storage facilities in our country. Diversification of potato utilization can solve this problem to some extent (Misra and Kulshrestha, 12). Conversion of potato to potato flour extends the shelf life of potatoes and lowers storage cost (Lakra and Sehgal, 9).

Dehydrated potato flour is a highly versatile and inexpensive raw material that can be incorporated in various value added products such as dehydrated snack premixes, which have a promising future due to its long shelf life and diverse uses. A premix is a mixture of ingredients designed to be mixed with other ingredients before use. The demand of such ready to fry premixes for the preparation of deep fried snacks is increasing continuously mainly due to convenience, improved living standards, urbanization growth, preference of new generation for fast foods and rise in per capita income.

Formulations of non-vegetable ready to fry dehydrated chicken kebab mix has been reported in the literature (Modi *et al.*, 13). However, there is no report available for the preparation of ready to fry dehydrated vegetable snack mix.

The demand for snack premixes is rising rapidly both in country and abroad. Since production of potato is abundant in India, so there is greater scope for

introduction of varieties of snack premixes prepared from these cost effective raw ingredients. Keeping this in view, this study was planned to develop and evaluate ready to fry dehydrated vegetable snack mix by incorporating potato.

MATERIALS AND METHODS

Materials

Potato cultivar 'Kufri Pukhraj' was procured from Vegetable Crops Department of the University and was used for production of dehydrated snack premix. Cassava flour, rice flour from broken kernels and spices (cumin, red chilli powder, green chilli powder), ginger, garlic, salt and corn starch were purchased locally.

Preparation of raw materials

Dehydrated potato flour : The tubers of Kufri Pukhraj' were peeled and cut into 2-3 mm thick slices with a rotary hand slicer. The slices were cooked in boiling water containing 0.25% potassium metabisulphite for 10 min to prevent enzymatic darkening (Marwaha and Sandhu, 11). Immediately after cooking, potato slices were cooled under running tap water. The sulphited slices were drained, loaded in trays and dried in hot air cabinet drier at $60^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 5 to 6 hr. The dried potato slices were ground in an electric grinder and then powdered in a cyclotec mill.

Preparation of dehydrated potato mix

Dehydrated potato snack mix was formulated by incorporating potato in different proportions.

Proportions of ingredients which were liked best sensorily were selected for the development of final product. Standardized recipe of dehydrated potato snack mix had the ingredients, potato flour 60g, rice flour 20g, cassava flour 20g, ginger and garlic paste 1.5g, cumin 0.6g, coriander powder 1.6g, red chilli powder 1.0g, green chilli powder 2.0g, corn flour 7.0g.

Analysis

Physicochemical analysis : The moisture, protein and ash contents of the raw materials and prepared snack premix were determined by official methods (AOAC, 1). Free fatty acids (as oleic acid) and Peroxide value was determined according to Standard AOAC (1) methods.

Phytochemical analysis : In the raw material and prepared snack premix, total phenolic content and antioxidant activity as DPPH radical scavenging activity was also determined.

Phenolic compounds were extracted from raw ingredients and dehydrated potato snack mix (5 g fresh tissue; 1 g dry ingredient) with 50 ml of 80% (v/v) aqueous methanol for 3 h at 40°C with refluxing. The content of total phenolic compounds in extract was determined using the Folin-Ciocalteu's colorimetric method (Singleton and Rossi, 17). The absorbance at 765 nm was measured after 30 min and the results were expressed as Gallic acid equivalents (mg GAE/100 g dw).

The antioxidant activity of aqueous extracts of raw materials and dehydrated potato snack mix was determined using 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical. The ability of the prepared extracts to scavenge the stable free radical was estimated using the method of Shimada *et al.* (18). Methanolic extract of sample was taken for antioxidant activity and calculated according to the following formula. BHT was taken as a standard at a fixed concentration of 5 mg/ml.

$$\text{Radical scavenging activity (\%)} = \frac{\text{Absorbance of control (0 minute)} - \text{Absorbance of sample (30 minute)}}{\text{Absorbance of control (0 minute)}} \times 100$$

Sensory quality evaluation of ready to eat potato snack prepared from dehydrated premix

For preparation of fresh potato snack, lukewarm water (240 ml) was added into the above mix and kneaded till the ingredients got uniformly mixed. Balls of 65g from the prepared dough were made and

flattened with hand. To impart a crispy texture, outer coating was given with bread crumbs. The snacks were then deep fat fried in a laboratory scale deep fat fryer maintained at $175 \pm 5^\circ\text{C}$ for 2 min. Freshly fried potato snack was then evaluated by a panel of 10 judges using 9-point Hedonic scale for sensory characteristics like appearance, flavor, texture and overall acceptability. The scores were assigned from extremely liked 9 to disliked extremely 1 (Larmond, 10)

Storage studies

Dehydrated potato snack premix was packed in 200 gauge polythene bags and sealed in tight air containers. The packed samples were exposed to room temperature ($26\text{-}38^\circ\text{C}/\text{RH } 35\text{-}87\%$) for a period of 6 months. Storage stability of the product was assessed by determining the changes in physicochemical parameters (moisture, ash and protein), rancidity parameters (free fatty acid content and peroxide value) and bioactive parameters (total phenolics, antioxidant activity). Sensorial analysis of ready to eat potato snack prepared from stored premix samples was done by a semi trained panel of 10 judges using 9-point Hedonic scale.

Statistical Analysis

All the experiments were carried out in triplicate. One-way analysis of variance was performed using the SPSS version 20.0 (Statistical Package for Social Sciences). Significant differences ($p < 0.05$) were determined by Tukey's.

RESULTS AND DISCUSSION

Proximate composition of raw ingredients

Potato flour used in the preparation of dehydrated snack mix contained 6.02 per cent moisture, 5.10 per cent protein and 0.94 per cent ash (Table 1). Data for protein and ash content is in line with those reported by Gahlawat and Sehgal (5) and Sandhu and Parhawk (16). Rice flour and spice mix used in the preparation of dehydrated snack mix had 9.10 and 3.10 per cent moisture, 7.21 and 0.11 per cent protein and 3.10 and 3.81 per cent ash (Table 1).

Potatoes are a significant source of antioxidant phytochemicals in the human diet. Phytochemicals such as polyphenols, ascorbic acid and carotenoids are the major bioactive compounds known in potato for their antioxidant properties (Ezekiel *et al.*, 3). In the present study, total phenolic content and antioxidant activity measured as DPPH radical scavenging activity of potato flour ranged 43.80 mg GAE/100g and 42.80 percent, respectively (Table 1). Rice flour used in the

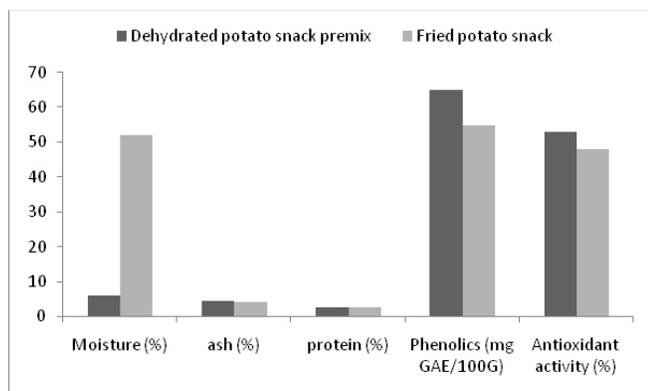


Fig. 1: Effect of frying on quality characteristics of ready to eat potato snack prepared from dehydrated potato snack premix.

preparation of dehydrated snack mix had 41.10 mg GAE/100g total phenolics and 21.10 per cent radical scavenging activity (Table 1). Sreeramulu *et al.* (19) reported 47.51 mg GAE/100g total phenolics in milled rice.

Table 1: Physicochemical and Phytochemical traits of raw ingredients used in development of dehydrated potato snack premix.

Raw ingredients	Moisture (%)	Protein (%)	Ash (%)	Total phenols (mg GAE/100 g)	Scavenging activity* (%)
Potato Flour	6.02±0.20 ^b	5.10±0.25 ^b	0.94±0.20 ^c	43.80±0.26 ^a	42.80±0.20 ^a
Rice flour	9.10±0.18 ^a	7.21±0.22 ^a	3.10±0.20 ^b	41.11±0.12 ^b	21.10±0.20 ^b
Spice mix	3.10±0.18 ^c	0.11±0.05 ^c	3.81±0.18 ^a	nd	nd

nd – not detected. Values within a column with different letters are significantly ($p < 0.05$) different. Mean values \pm SD ($n=3$)

Quality characteristics of fresh and stored dehydrated potato mix

Moisture content

Moisture content in fresh dehydrated potato snack premix ranged 6.02% (Table 2). During storage, there was a gradual increase ($p < 0.05$) in the moisture content of dehydrated snack mix. As seen in Table 2, the moisture content increased from 6.02 to 8.34%

during 6 months of storage. This might be due to variation in atmospheric relative humidity, which ranged from 35-85% during the storage period. Similar results were documented by Misra and Kulshrestha (12) and Raj *et al.* (14) during storage of dehydrated potato flour.

Ash and Protein content

The ash and protein content in dehydrated potato mix ranged 2.83-2.89% and 4.50-4.57% respectively during storage (Table 2). However, changes in ash and protein content during storage were found to be non-significant (Table 2).

Free Fatty acid (FFA) and Peroxide value (PV)

Percentage FFA and PV are the rancidity parameters indicating the oxidation of fat during storage of food products resulting in off flavor. FFA and

PV in fresh dried potato mix ranged 0.111% and 0.23 meq O₂/kg fat, respectively (Table 2). During storage, no significant ($p < 0.05$) difference in the levels of FFA and PV in dehydrated potato mix were observed (Table 13). However, Modi *et al.* (3) observed a significant increase in FFA values of dehydrated chicken kebab mix stored at ambient temperature for six months.

Table 2: Quality characteristics of fresh and stored dehydrated potato snack premix.

Storage period (months)	Physicochemical properties					Phytochemical properties	
	Moisture (%)	Ash (%)	Protein (%)	Free fatty acids (%)	Peroxide value (meq O ₂ /kg fat)	Total phenols (mg GAE/100g)	Scavenging activity (%)
0	6.02 ± 0.20 ^c	2.89±0.05 ^a	4.50±0.28 ^a	0.110±0.001 ^a	0.23±0.01 ^a	65.20±0.38 ^a	53.14 ± 0.25 ^a
3	7.60±0.27 ^b	2.83±0.15 ^a	4.57±0.15 ^a	0.109±0.001 ^a	0.25±0.03 ^a	61.16±0.28 ^b	48.81± 0.20 ^b
6	8.34±0.11 ^a	2.85±0.11 ^a	4.52±0.21 ^a	0.110±0.001 ^a	0.24±0.02 ^a	58.81±0.25 ^c	42.80± 0.10 ^c

Values within a column with different letters are significantly ($p < 0.05$) different. Mean values \pm SD ($n=3$)

Total phenolic content

Phenolic compounds are secondary plant metabolites (phytochemicals) with antioxidant activity, which contributes to the physiological defense against oxidative and free radical mediated reactions (Babbar *et al.*, 2). During storage, there was significant ($p < 0.05$) decrease in the total phenolic content of prepared dehydrated potato snack mix (Table 2). The phenolic content declined from initial value of 65.20 to 58.82 mg/100g after 6 months of storage (Table 2). This decrease in phenolics might be due to degradation from the effect of heat, which increases with increase in storage temperature (Ezekiel *et al.*, 3). Similar results for total phenols were documented by Ezekiel *et al.* (4) during storage of raw potato cultivars. The change in total phenolics content of dehydrated snack mix during the entire storage period from the initial values was 9.78%. According to Gitanjali *et al.* (6) the level of phenols present in fruits and vegetables can be influenced by growing conditions, harvest conditions, species, processing methods and storage conditions.

DPPH radical scavenging activity

During storage period, antioxidant capacity of dehydrated potato snack premix measured as DPPH radical scavenging activity decreased significantly ($p < 0.05$) (Table 3). Radical scavenging activity in dehydrated mix reduced from 53.14% zero month to 42.80% after six months of storage (Table 3). The decrease in the antioxidant activity might be related to decrease in the levels of bioactive compounds such as phenolic compounds during storage (Klimczak *et al.*,

Effect of frying on quality characteristics of ready to eat potato snack prepared from dehydrated snack premix

Significant ($p < 0.05$) difference was found in the moisture content of dehydrated snack mix and ready to eat fried potato snack made from it (Fig. 1). Frying resulted in non-significant ($p < 0.05$) changes in ash and protein content. As for bioactive components, frying significantly ($p < 0.05$) affected the total phenolic content and antioxidant activity of ready to eat potato snack (Fig.1). The total phenolics and antioxidant activity of ready to eat fried potato snack ranged 54.88 mg GAE/100g and 48.12 per cent, respectively. This might be due to thermolabile nature of these compounds which resulted in their loss during frying. Similar reductions in bioactive compounds were noticed during shallow frying of raw potatoes (Gitanjali *et al.*, 6).

Sensory quality of ready to eat potato snack prepared from dehydrated snack premix

The effect of storage on the sensory quality of ready to eat potato snack prepared from dehydrated premix stored at room temperature (26-38°C/RH 35-87%) is represented in Table 3. Prepared snack was found to be highly desirable up to 6 months of storage. Dehydrated potato mix samples were free from fungal infestation and were found to be highly desirable up to 6 months of storage. Incorporation of unmarketable potato cultivars into low-cost value added products such as dehydrated premixes could serve as an excellent vehicle for enhancing the utilization of this resourceful food crop.

Table 3: Sensory evaluation of ready to eat potato snack prepared from fresh and stored dehydrated premix

Storage period (months)	Appearance	Flavor	Texture	Overall acceptability
0	8.51 ± 0.01 ^a	8.41 ± 0.03 ^a	7.91 ± 0.04 ^a	8.29 ± 0.02 ^a
3	8.47 ± 0.01 ^b	8.37 ± 0.04 ^b	7.88 ± 0.02 ^a	8.24 ± 0.04 ^a
6	8.45 ± 0.02 ^b	8.21 ± 0.03 ^c	7.80 ± 0.02 ^a	8.18 ± 0.03 ^b

Values within a column with different letters are significantly ($p < 0.05$) different. Mean values ± SD ($n=3$)

7). Kaur and Kapoor (8) and Reyes *et al.* (15) established a high positive correlation between antioxidant activity and total phenolics of plant foods. The authors concluded that total phenolics are the major components responsible for the total antioxidant activity. In our study, the loss in total antioxidant capacity as radical scavenging activity accounted for 19.45% after 6 months of storage.

Conclusion

A simple process for preparation of dehydrated potato snack premix was standardized. The developed snack premix displayed excellent keeping quality for 6 months of storage at ambient temperature and maintained the sensory attributes throughout the storage period. This low cost premix could be successfully prepared from underutilized low dry matter and high sugar varieties which are considered

unfit for processing. Moreover, the developed ready-to-fry snack premix can provide convenience to the consumers by restricting the kitchen drudgery and time involved in the preparation of the snack.

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