World Journal of Dairy & Food Sciences 3 (2): 34-38, 2008
ISSN 1817-308X

Effect of Incorporation of *Dioscorea alata* Flour on the Quality and Sensory Attributes of Indian Dehydrated Products

N.S. Siddaraju, Faiyaz Ahmed and Asna Urooj

Department of Studies in Food Science and Nutrition, University of Mysore, Mysore, India

Abstract: *Dioscorea alata* (winged yam) is widely cultivated in the tropical and subtropical regions of the world and known for its high carbohydrate content. Starch is the major carbohydrate reserve accounting 85% of dry matter. In the present investigation, the physico-chemical properties (water absorption capacity, fat absorption capacity and bulk density) of *Dioscorea alata* were analyzed. The flour of *Dioscorea alata* was incorporated at two different levels (20 and 30%) in two dehydrated food products viz, *papad* and *sandige* and the products were studied for sensory acceptance. The papad with 20 and 30% *Dioscorea alata* flour were comparable to control with respect to all sensory attributes like appearance, aroma, taste, after taste and overall quality except in terms of color even after two months of storage. sandige with 20 and 30% *Dioscorea alata* flour were comparable to control with respect to all sensory attributes like appearance, texture, aroma, taste, after taste and overall quality except in terms of color even after two months of storage. The oil uptake by the two products with *Dioscorea alata* flour was less when compared to control. The results emphasize that *Dioscorea alata* flour can be utilized in the preparation of dehydrated food products.

Key words: *Dioscorea alata* · Papad · Sandige · Sensory analysis · Yam

INTRODUCTION

Dioscorea alata (winged yam) is widely cultivated in the tropical and subtropical regions of the world and known for high carbohydrate and medicinal values. Starch is the major carbohydrate reserve accounting upto 85% of dry matter [1]. *Dioscorea alata* (DA) tubers are known to contain alkaloid (dioscorine), tannins and saponins [2]. The tuber is used in number of ways such as soup thickener, as fried chips and as fried mashed yam balls, it is also used in baked product as reconstituted dough and yam flakes [3].

Papads have been popular food adjunct in Indian dietary for centuries. Papad is a dehydrated circular disc made of cereal or pulse flour, that is consumed in roasted (dry) or deep fat fried form that resembles thin wafer [4]. Papads are generally made from dough of cereal/pulse/edible starch flour separately or in blends along with salt, spices, edible oil and additive, Papad khar-chemically a combination of carbonate, bicarbonates, sulfates and chlorides [5]. Studies have reported possibilities of incorporating certain ingredients such as soy flour, cheese powder, cooked unripe banana and cooked colocasia into Papads [6-9].

Sandige is an extruded dehydrated product with irregular shape and brittle texture. It is a popular food adjunct in South Indian diet and is consumed after frying along with entrees. Traditionally, sandige is prepared from cereal flours of rice, ragi, puffed rice and sago [10]. The present study was planned to utilize DA flour in the preparation of two dehydrated products viz. papad and sandige and evaluate their acceptability.

MATERIALS AND METHODS

Materials: *Dioscorea alata* tuber (DA) was collected from Western Ghats, India. The tuber was washed and the non edible portion (peel) was discarded. The tuber was then rated, sun dried, powdered, passed through 60 mesh sieve and stored in air tight container till further use.

Preparation of Papad: Papads were prepared by partially replacing black gram dhal flour (*Phaseolus mungo* Roxb.) with DA flour at two different levels (20 and 30%). The ingredients were mixed with water and kneaded to get a homogenous lump of dough. The dough was divided into small balls and rolled into thin circular discs of about 1 mm thickness and 10-12 cm diameter and sun dried.

Corresponding Author: Dr. Faiyaz Ahmed, Department of Studies in Food Science and Nutrition, University of Mysore, Mysore, India

Preparation of Sandige: Sandige were prepared by incorporating DA flour at two different levels (20 and 30%). The ingredients were mixed with water and gelatinized at 60-70°C to get a dough consistency. The dough was then extruded and sun dried.

Physico-Chemical Properties: Bulk density, water absorption capacity, fat absorption capacities were determined in the flour and oil absorption during frying was determined in the products [11].

Sensory Analysis: Raw papads and sandige were fried in refined sunflower oil for 6-8 seconds (185±2°C), coded in random order and served to a trained panel of 10 members. They scored the control and experimental samples for all sensory attributes: color, appearance, texture, aroma, taste, after taste and overall quality.

Statistical Analysis: The data was analyzed by ANOVA followed by Duncan's new multiple range test for significant differences using SPSS 14.0 software. Values were considered significant at $p<0.05$.

Storage Studies: Raw papads and sandige were stored for a period of two months in air tight plastic container and evaluated for sensory characteristics at seven days interval.

RESULTS

Functional Properties of Flours: The functional properties of flours are given in Table1. The water Absorption Capacity (WAC) of *Dioscorea alata* flour was higher than rice flour and fat absorption capacity was lower than rice flour which is comparable to black gram dhal flour. The bulk density of *Dioscorea alata* flour and rice flour was similar which was lower than black gram dhal flour.

Studies on Papad: Physical characteristics of dough and rolling properties are given in Table 2. In preparation of the dough, besides uniformly distributing the ingredients, water also determines dough plasticity essential for rolling. The optimum water required for the preparation of dough was more in both the variations. Hand feel was

Table 1: Functional properties of flours

Properties	Dioscorea alata flour	Blackgram dhal flour (*phaseolus mungo roxb*)	Rice flour
Water absorption Capacity (ml/100g)	140	160	80
Fat absorption Capacity (ml/100g)	80	80	100
Bulkdensity (g/100ml)	120	140	120

Table 2: Dough characteristics of papad

Variation	Water used	KneadingTime (ml)	Handfeel (min)	Rolling property
Control	45	4	Soft	Easy to roll
DA20	50	6	Soft	Easy to roll
DA30	55	7	Tough	Easy to roll

Control-100% Black gram dhal flour (*Phaseolus mungo* Roxb)

DA20-80% Black gram dhal flour and 20% *Dioscorea alata* flour

DA30-70% Black gram dhal flour and 30% *Dioscorea alata* flour

Table 3: Characteristics of papad

Variation	Appearance	Colour	Texture	Diametrical expansion (%)	Oil uptake (%)
Raw Papad					
Control	Uniform	Cream	Brittle	-	-
DA20	Uniform	Brown	Brittle	-	-
DA30	Uniform	Dark Brown	Brittle	-	-
Fried Papad					
Control	Uniform	Brown	Crunchy	9. 52	16. 90 ±0.20^{b}
DA20	Uniform	Light Brown	Crunchy	9. 09	15.48±0.38^{ab}
DA30	Uniform	Brown	Crunchy	8. 30	14.60 ±0.41^{a}

*Values bearing different superscript a, b, c……..in columns differ significantly different at $p \leq 0.05$

Control-100% Black gram dhal flour (*Phaseolus mungo* Roxb)

DA20-80% Black gram dhal flour and 20% *Dioscorea alata* flour

DA30-70% Black gram dhal flour and 30% *Dioscorea alata* flour

Table 4: Mean scores of sensory attributes of papad

	Variation	Appearance	Colour	Texture	Aroma	Taste	After taste	Overall Quality
BF	Control	8.30.94[a]	100.01[c]	8.2±0.48[a]	7.5±0.70[a]	7.1±0.56[a]	6.9±1.03[a]	7.1±0.67[a]
	DA20	8.6±0.31[b]	5.5±0.67[b]	8.1±0.48[a]	7.1±0.42[a]	6.8±0.67[a]	7.6±0.96[a]	7.3±0.56[a]
	DA30	8.3±0.21[a]	4.8±0.96[a]	8.3±0.31[a]	7.4±0.51[a]	6.4±0.51[a]	7.9±0.92[a]	7.5±0.66[a]
AS1	Control	8.5±0.31[b]	8.5±0.31[b]	8.1±0.63[a]	7.9±0.67[b]	7.7±0.52[a]	7.5±0.84[b]	7.2±0.67[a]
	DA20	6.8±0.87[a]	5.2±0.48[a]	7.8±0.94[a]	7.2±0.63[a]	7.2±0.22[a]	6.9±0.84[a]	7.1±0.67[a]
	DA30	7.2±0.94[a]	4.8±0.63[a]	8.1±0.42[a]	7.5±0.51[a]	7.5±0.42[a]	6.9±0.96[a]	7.1±0.82[a]
AS2	Control	8.6±0.48[a]	8.2±0.52[c]	8.5±0.53[b]	7.5±0.42[a]	8.1±0.48[b]	8.3±0.79[a]	8±0.50[a]
	DA20	8.4±0.46[a]	4.6±0.38[b]	7.9±0.48[ab]	7.1±0.67[a]	7.7±0.32[ab]	8.5±0.67[a]	7.5±0.48[a]
	DA30	8.4±0.46[a]	3.1±0.31[a]	7.5±0.42[a]	7.2±0.74[a]	7.4±0.52[a]	7.6±1.14[a]	7.1±0.52[a]

BS-Before Storage, AS1-after 7 days storage, AS2- after 2 months storage

*Values bearing different superscript a, b, c……..in columns differ significantly different at $p \leq 0.05$

Control-100% Black gram dhal flour (*Phaseolus mungo* Roxb)

DA20-80% Black gram dhal flour and 20% *Dioscorea alata* flour

DA30-70% Black gram dhal flour and 30% *Dioscorea alata* flour

Table 5: Dough charecteristics of sandige

Variation	Water used (ml)	Gelatinization temperature (°C)	Dry weight (gm)
Control	200	68	68.3
DA20	220	70	78.4
DA30	220	70	80.2

Control-100% Black gram dhal flour (*Phaseolus mungo* Roxb)

DA20-80% Black gram dhal flour and 20% *Dioscorea alata* flour

DA30-70% Black gram dhal flour and 30% *Dioscorea alata* flour

Table 6: Charecteristics of sandige

Variation	Colour	Texture	Shape	Oil uptake (%)
Raw Sandige				
Control	White	Brittle	Retains	-
DA20	Brown	Brittle	Retains	-
DA30	Dark Brown	Brittle	Retains	-
Fried Sandige				
Control	White	Crisp	Retains	22.24±0.36[b]
DA20	Light Brown	Brittle	Retains	21.42±0.41[b]
DA30	Dark Brown	Brittle	Retains	20.18±0.54[a]

*Values bearing different superscript a, b, c……..in columns differ significantly different at $p \leq 0.05$

Control-100% Black gram dhal flour (*Phaseolus mungo* Roxb)

DA20-80% Black gram dhal flour and 20% *Dioscorea alata* flour

DA30-70% Black gram dhal flour and 30% *Dioscorea alata* flour

tough in DA30 and the elasticity of dough was low compared to control. However, cohesiveness and rolling properties of dough were similar and kneading time was more in both the variations.

The physical characteristics of papad are given in Table 3. The color of the papad was less appealing than that of control (100% black gram dhal papad). All the papads were uniform in thickness and texture remained brittle.

All papads after frying had a uniform appearance (Table 3). The quality of fried DA20 and DA30 papad was considered very close to the control with respect to aroma, texture (crunchy) and taste except in terms of color which was brown. Expansion quality of both the variations was decreased compared to control. Oil uptake by the products during frying was significantly ($p<0.05$) low in DA30 when compared to control where as DA20 was comparable to control.

The mean scores of sensory parameters are given in Table 4. The DA20 and DA30 were comparable in all the sensory parameters except in color, the mean sensory scores of color was significantly ($p<0.05$) decreased compared to control. The mean sensory scores of all the papads were almost similar even after seven days and two months of storage. Physical characteristics of raw papads remained unchanged during storage period. Sensory scores of fried papads by the same panelists were almost similar to the earlier scores.

Studies on Sandige: Dough characteristics of sandige are given in Table 5. Water used to make dough was more in DA20 and DA30 and gelatinization temperature was higher compared to control

The physical characteristics of sandige are given in Table 6. The color of the sandige was less appealing than that of control (100% rice flour). All the sandige were uniform in appearance and brittle texture to. sandige after frying had a uniform appearance (Table 6). The quality of fried DA20 and DA30 sandige were considered very close to control with respect to aroma and taste except color which was brown and texture remained brittle even after frying.

Table 7: Mean scores of sensory attributes of sandige

	Variation	Appearance	Colour	Texture	Aroma	Taste	After taste	Overall Quality
BF	Control	4.1±1.9[a]	7.2±0.63[b]	8.2±0.48[a]	8.9±0.32[a]	8.1±0.7[a]	8.9±0.32[a]	7.1±0.63[a]
	DA20	6.1±1.9[b]	4.2±0.4[a]	8.1±0.67[a]	7.9±0.69[a]	7.2±1.13[a]	7.30.51[a]	6.5±0.67[a]
	DA30	6.2±0.7[b]	4.0±0.01[a]	7.4±0.78[a]	8.3±0.67[a]	8.1±0.84[a]	7.5±0.87[a]	6.4±0.67[a]
AS1	Control	7.2±1.03[b]	7.1±0.56[c]	8.2±0.69[b]	8.6±0.45[b]	8.2±0.63[b]	7.9±0.67[b]	8.5±0.52[b]
	DA20	7.3±0.91[b]	5.2±0.51[b]	7.9±0.94[b]	8.5±0.42[b]	6.3±1.41[a]	6.5±1.15[a]	6.3±0.78[a]
	DA30	6.8±1.08[a]	4.1±0.66[a]	6.5±1.07[a]	7.8±0.84[a]	5.8±1.49[a]	6.3±1.03[a]	5.9±0.96[a]
AS2	Control	9.0±0.01[b]	7.3±0.52[c]	7.8±0.32[b]	9.0±0.01[a]	8.4±0.61[a]	8.3±0.42[a]	8.5±0.53[b]
	DA20	8.7±0.48[b]	6.0±0.01[b]	7.5±0.39[ab]	9.0±0.01[a]	7.9±0.31[a]	7.9±0.51[a]	7.1±0.41[a]
	DA30	6.8±0.14[a]	3±0.01[a]	7.1±0.46[a]	8.4±0.42[a]	7.3±0.55[a]	7.4±0.48[a]	7.0±0.63[a]

BS-Before Storage, AS1-after 7 days storage, AS2- after 2 months storage

*Values bearing different superscript a, b, c……..in columns differ significantly different at $p \leq 0.05$

Control-100% Black gram dhal flour (*Phaseolus mungo* Roxb)

DA20-80% Black gram dhal flour and 20% *Dioscorea alata* flour

DA30-70% Black gram dhal flour and 30% *Dioscorea alata* flour

Oil uptake by the products during frying (Table 6) was significantly lesser in DA30 when compared to control but in case of DA20 was comparable to control.

The mean scores of sensory parameters are given in Table 7. The DA20 and DA30 were comparable to control in all sensory parameters except color and appearance. In terms of color, both DA20 and DA30 were less acceptable. However, in terms of appearance they were significantly better acceptable than that of control. The mean sensory scores of sandige were almost similar even after seven days and two months of storage with respect to aroma, taste and after taste. In terms of appearance, DA20 sandige was comparable to control but DA30 sandige was significantly less acceptable than that of control. Physical characteristics of raw sandige remained unchanged during storage period. Sensory scores of fried sandige by the same panelists were almost similar to the earlier scores.

DISCUSSION

The results of the present study reveal that it is possible to prepare dehydrated products such as papad and sandige by incorporating *the Dioscorea alata* flour at two different levels (20 and 30%), respectively. Overall quality, appearance, aroma, taste and after taste were comparable to control in both fresh and stored products. However, the dough characteristics and physical characteristics of the products were adversely affected in terms of color. As the proportion of *Dioscorea alata* increased the water required to prepare the dough also increased which may be due to high water binding capacity of *Dioscorea alata* flour [12] and gelatinization temperature of DA20 and DA30 was high. The texture of the fried products remained brittle where as in control it was crisp. Differences in shape and gelatinization temperature (amylose: amylopectin ratio) of *Dioscorea alata* starches may be responsible for textural differences [13]. However, oil uptake by the products during frying decreased significantly ($p<0.05$) in both the variations, this may be due to low fat absorption capacity of *the Dioscorea alata* flour.

The sensory scores of DA20 and DA30 products (papad and sandige) were significantly low in terms of color in both fresh and stored products indicating lesser acceptability. This may be due to the brown color of the *Dioscorea alata* flour. However, there was no significant difference in other sensory characteristics even after two months of storage indicating the acceptability of the products.

CONCLUSION

From the results of the study carried out, it can be concluded that it is possible to prepare papad and sandige with incorporation of *Dioscorea alata* flour at 20 and 30% as the products were acceptable even after two months of storage. The results indicate that *Dioscorea alata* flour can be utilized in the preparation of various dehydrated food products.

REFERENCES

1. Cliff, K.R., A.A. Sarafadeen, O.W. Andrew and N.A. Helen, 2006. Fundamentals and derived properties of yam (*Dioscorea species*) starch powder and applications in Tablet and Capsule formation. Starch/strake, 58: 418-424.

2. Anonymous, 1987. Root Crops, 2nd Edn, pp: 308.
3. Osagie, A.U., 1992. The yam tuber in storage. Postharvest Research Unit, University of Benin, Benin City, pp: 33-84.
4. Saxena, A.K., J.K. Manan, S.G. Kulkarniand and I.C. Shukla, 1996. Papad (A food adjunct) industry in India-a resume. Indian Food pack., 50(6): 102-110.
5. Venkatesh, K.V.L., S.R. Shurpalekar, J.V. Prabhakar and B.L. Amla, 1970. Physico-chemical characteristics of Papad (sajji) Khar. J. Food Sci. Technol., 7: 106-109.
6. Kulkarni, S.G., J.K. Manan and I.C. Shukla, 1992. Preparation of, evaluation and storage of papads made from rice flakes (poha) flour and unripe banana. Beverage Food world, 19(5): 13-18.
7. Kulkarni, S.G., J.K. Manan and I.C. Shukla, 1995. Standardization of conditions for the preparation, evaluation and storage of papads made from rice flakes (poha) flour, colocasia and sago. Beverage Food World., 22(1): 22-28.
8. Srinivasan, P., U.S. Annapure, K.A. Sahoo, S.R. Singhal and P.R. Kulkarni, 2000. Mini-papad containing cheese powder. Intl. J. Food Sci. Nutr., 51: 175-180.
9. Singh, S., S. Narang, V.G. Annageri and V. Anand, 2001. An agribusiness systems study of papad industry. Indian Food Ind., 20(6): 22-25.
10. Hemalatha, C.S., A. Urooj and S. Puttaraj, 1995. Utilization of Cowpea flour in the preparation of sandige. J. Food Sci. Technol., 32(2): 144-146.
11. Ranganna, S., 1986. Handbook of analysis and quality control for fruit and vegetable products, Tata McGraw-Hill, New Dehli, pp: 105-106.
12. Emiola, L.O. and L.C. Delarosa, 1981. Physicochemical characteristics of yam starches. J. Food Biochemi., 5: 115-130.
13. Onayemi, O.R., O. Babalola and A. Badanga, 1987. Textural properties of cooked yam (*Dioscorea spp)*. J. Texture Studies., 18: 17-29.