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Development of Nutrient rich Sweet Potato and Taro based Composite Flour Cookies

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ABSTRACT

The study elucidates the utilization of composite flour for development of cookies and to analyze the physical and sensory characteristics. Cookies contribute valuable quantities of iron, calcium, protein, calorie, fiber and some of the B-vitamins to our diet and daily food requirements. The formulation of non-wheat flour from tuber-cereal-legume-oilseed combinations and the replacement of gluten, in cereal based bakery products still become a significant challenge. Therefore, this research paper presents the development of cookies based on sweet potato flour and taro flour with sorghum, chickpea and flaxseed flours at different ratios. The physical changes in case of both, sweet potato flour and taro flour based cookies were varied significantly. The sensory evaluation (appearance, color, flavor, texture, taste and overall acceptability of cookies)of sweet potato based composite flour cookies, showed a significant difference and the highest score for overall acceptability was recorded with the blend ratio of 60% sweet potato flour, 20% sorghum flour,15% chickpea flour and 5% flax seed. The results for taro based composite flour cookies were non-significant in respect of appearance, color, flavor and texture, only the taste and overall acceptability varied significantly and the highest overall acceptability was recorded with 70% taro flour, 15% sorghum flour, 10 % chickpea flour, 5% flax seed of composite blend.

***Key Words**: Sweet Potato, Taro, Composite Flour, Cookies, Nutrient*

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INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) and taro (*Colocasia esculenta* L.) are the important tuber crops used as staple or subsistence food by millions of people in developing nations. Sweet potato the fifth most important food crop, is a short duration creeper (90-110 days). This crop seems to be most suitable to grow and check soil erosion in degrading and fragile lands as ecofriendly crop to cater food (194 MJ/ ha/day), feed, nutritional [vitamin C (23 mg/100g), + vitamin E (4.56 mg/100g)] and industrial demands (16-20% starch) [1].India is said to be the secondary centre of origin of taro endowed with diverse genetic resources. Among many flours root crops are the alternative sources that are rich in starch. Although compared to wheat flour with high protein content, roots crop such as taro and sweet potato can be considered as an alternative ingredient for cakes and other bakery products that also have a considerable amount of nutrient and vitamins[2]. Sweet potato and taro are two conventional tuber crops that are very nutritious and very abundantly available in north east. So, the two different composite flours were prepared using sweet potato and taro based with different combinations of sorghum, chickpea and flax seed flours.

Despite a recent advance in formulation of non-wheat flour from cereal-tuber-legume combination, the replacement of gluten in cereal-based products, such as bread, biscuit, cake and pasta, still represent a significant challenge of technology[3]. This study is one of the efforts to promote the use of composite flours in which flour from locally grown tuber crops and other flours such as sorghum flour, chick pea flour, flax seed flour with high nutritional content was used to produce nutrition-enriched composite flour. Thus, the aim of this work was to evaluate the optimum proportion of sweet potato flour and taro flour with other flour for development of cookies from composite flour. Composite flour are better utilized for cookies production rather than for bread because of their ready-to eat form, relatively prolonged shelf-life, wide consumption and good eating quality and also formulation of composite flour may be considered as an important tool for enriching any food product

Cookies are convenient food products consumed nearly by all levels of society. Some of the reasons for such wide popularity are varied taste, easy availability, longer shelf life and low cost among other processed foods. Cookies are nutritive snacks produced from unpalatable dough that is transformed into appetizing product through the application of heat in an oven [4]. They are ready to-eat, conveniences and inexpensive food product, containing digestive and dietary principle of vital importance [5]. Cookies are the substantial source of energy because they considered to be a concentrated food due to high contents of carbohydrates, fats and low moisture. Another important aspect in designing cookies with improved nutritional status is the maintenance of a product's sensory characteristics because the consumer's acceptability remains the key factor which determines the successful application of a newly developed product[6]. Therefore, this study intended to produce nutrient-rich and affordable cookies which were made from sweet potato and taro based composite flour and would help to tackle nutrient deficiency to a certain extent.

MATERIAL AND METHODS

The present study was carried out to develop a composite flour based cookies for which different flours were prepared.

Methods

Flour preparation

Sweet potatoes and taro corms were washed properly under potable running water and peeled with a stainless steel knife. After peeling, again the potatoes and taros were re-washed and cut into thin slices into 2 mm thickness and were blanched for 2 mins with distilled water for 90-98ºC. The slices were removed after 2 min with a sieve to allow adhering water to drain and spread thinly on trays. Drying was done in tray dryer at 65ºC till the moisture content was 4-5 per cent. The dried sweet potato slices and taro slices were milled into flour using a grinder which passed through 80 mesh sieve. The flour obtained was stored in an air tight container for later use.

The chickpea brought from the market are washed thoroughly to remove dust and other foreign materials. Cleaned chickpea granules are then roasted in a pan for 10-15 mins. The roasted granules were grounded in electric grinder to make fine powder and sieved by 80 mesh sieve. The obtained flour was stored in airtight container before use. Sorghum and Flax seed flours were purchased from the market and were kept in air tight containers for the preparation of composite flour.

Blends formulation

Ten types of blends were prepared to make composite flour mix. A sweet potato based blends contained sweet potato flour, sorghum flour, chickpea flour and flax seed flour in different ratios viz. 80:10:5:5 (S1),70:15:10:5 (S2), 60:20:15:5 (S3), 50:25:20:5 (S4), 40:30:25:5 (S5). And the blends containing taro flour in different ratios viz. 80:10:5:5 (T1), 70:15:10:5 (T2), 60:20:15:5 (T3), 50:25:20:5 (T4), 40:30:25:5 (T5) were also prepared. These different blends were used for cookies development which were further used for sensory evaluation.

Development of cookies

Preparations of cookies:

Cookies were prepared according to the modified method reported by Barooah and Bhattacharya[7].The Margarine (75 g), Sugar (40 g), Baking powder (2 g), Salt (1 g) were used as ingredient for development of composite flour (100g) based cookies.

Procedure of cookies development:

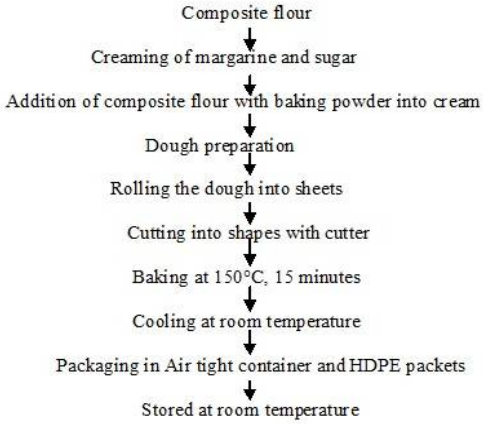

Fig.1: Flow chart for preparation of cookies

Determination ofPhysical properties of developed cookies

Diameter

The diameter of the cookies was determined according to the AOAC method [8]. Three cookies were placed edge to edge and their total diameter was measured with the aid of a ruler. The experiment was repeated thrice and average diameter was recorded in centimeter.

Diameter = $\frac{Total\ diameter\ (cm)}{No.of cookies}$

Thickness

The thickness of the cookies was determined according to the AOAC method [8]. The cookies thickness was measured with the aid of a digital vernier caliper. The experiment was repeated thrice and average thickness was recorded in centimeter.

Spread Ratio

Cookie spread factor was calculated by dividing the average value of diameter by average value of thickness of cookies [8]. The experiment was repeated thrice and average Spread factor was recorded.

Spread ratio = $\frac{Average\ value\ of\ diameter\ (cm)}{Average\ value\ of\ thickness\ (cm)}$

Sensory evaluation of the cookies

Sensory evaluation of the cookies was carried out according to the method described by [9] based on 9 point hedonic scale. A panel of fifteen members consisting of students and members of staff were chosen based on their familiarity and experience for sensory evaluation. Cookies produced from each flour blend were presented in coded form on disposable plates and were randomly presented to the panelists. The panelists were provided with water to rinse their mouth between evaluations. However, a questionnaire describing the quality attributes (appearance, colour, taste, flavour, texture and overall acceptability) of the cookies was given to each panelist. The panelist assigned scores for each parameter as against the maximum score of 9. Each sensory attribute was rated on a 9-point

RESULTS AND DISCUSSION

Physical properties of developed cookies

Diameter, thickness and spread ratio

The diameter of sweet potato based cookies ranged from 4.23 cm to 4.53cm (± 0.05) and taro based composite cookies ranged from 4.13 cm to 4.33 cm (± 0.05) were shown in Table 1. The diameter of the developed cookies increased significantly which might be attributed to increased percentage inclusion of sorghum and chickpea flour which are rich in protein and fiber content. Mridula (2011) who stated that the expansion in diameter of carrot pomace powder incorporated biscuits decreased with increasing levels of carrot pomace powder, which may be due to increased fiber content in the biscuits [10].

The thickness of sweet potato based composite flour cookies ranged from 0.53 to 0.83 cm (± 0.05) and taro based composite cookies ranged from 0.57 to 0.73 cm (± 0.05) were shown in Table 1. It was observed that the thickness of the developed cookies increased significantly which may be attributed to increased percentage inclusion of sorghum and chickpea flour which are rich in protein and fiber content. Moreover, it could also be attributed to the high absorption of moisture in the dough.

Table 1 showed the spread ratio of sweet potato based composite flour cookies which ranged from 5.46to7.99(± 0.05)and taro based composite cookies ranged from 5.94 to 7.25(± 0.05). The differences in spread ratio of the cookies of sweet potato and taro based composite flour may be attributed to the differences in swelling patterns and rheological properties. The decreasing trend in the spread ratio was attributed to the fact that composite flours apparently form aggregates with increased numbers of hydrophilic sites available that compete for the limited free water in dough [11].

Table 1. Physical properties of developed cookies from sweet potato & taro based composite flour

Physical properties	Taro blend formulation							Sweet potato blend formulation						
	T_1	T_2	T_3	T_4	T_5	S.Ed (±)	CD (5%)	S_1	S_2	S_3	S_4	S_5	S.Ed (±)	CD (5%)
Diameter (cm)	4.13	4.23	4.20	4.23	4.33	0.04	0.09	4.23	4.23	4.30	4.47	4.53	0.04	0.20
Thickness (cm)	0.57	0.60	0.57	0.70	0.73	0.03	0.08	0.53	0.63	0.63	0.77	0.83	0.06	0.15
Spread ratio	7.25	7.05	7.37	6.05	5.94	0.46	1.04	7.99	6.72	6.83	5.85	5.46	0.44	1.00

Sensory evaluation of developed cookies

The sensory scores of cookies developed from sweet potato and taro based composite flour are presented in fig 2 and 3 respectively. Mean scores of appearance, color, flavor, texture, taste and overall acceptability of sweet potato based composite flour cookies are statistically significant. But the mean scores of appearance, color, flavor and texture of taro based composite cookies were non-significant only the taste and overall acceptability are statistically significant. All cookies sample were rated as acceptable by the panel. Overall acceptance scores indicated for sweet potato based composite flour are S1=6.70, S2=6.25, S3=7.80, S4=7.15 and S5=7.30 and taro based composite flour are T1=6.90, T2=7.90, T3=7.20, T4=7.60 and T5=7.10. Data indicated that the percent score of cookies containing 60% sweet potato flour i.e. treatment S3 and 70% taro flour i.e. treatment T2 were found to be the most acceptable. Although, all samples were rated above average and overall cookies quality at the different levels of substitution was found to be acceptable.

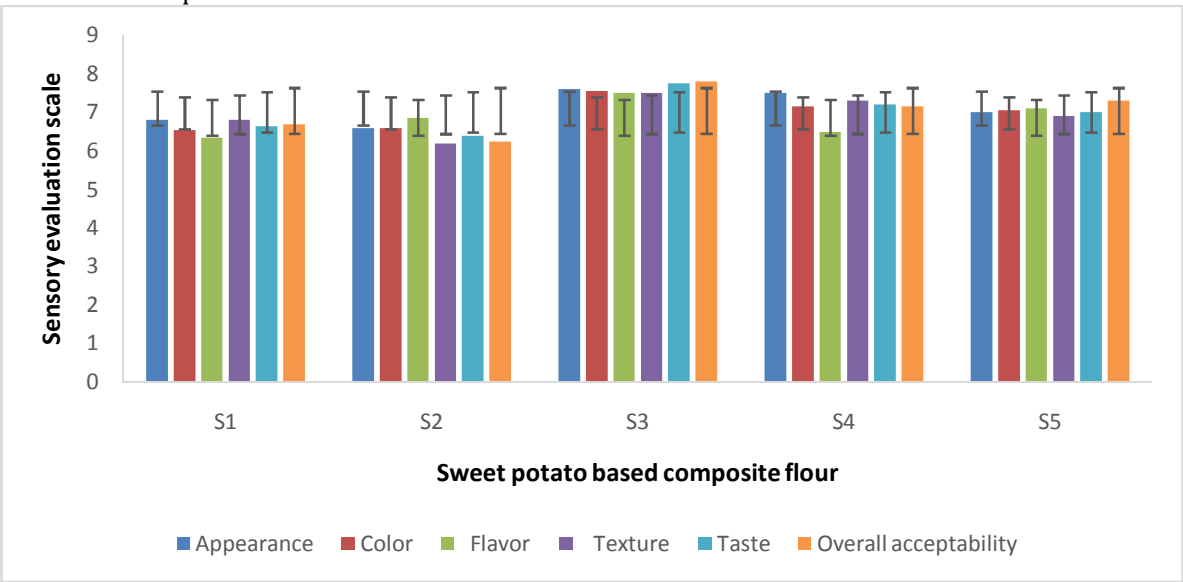

Fig 2. Sensory evaluation of cookies developed from sweet potato based composite flour

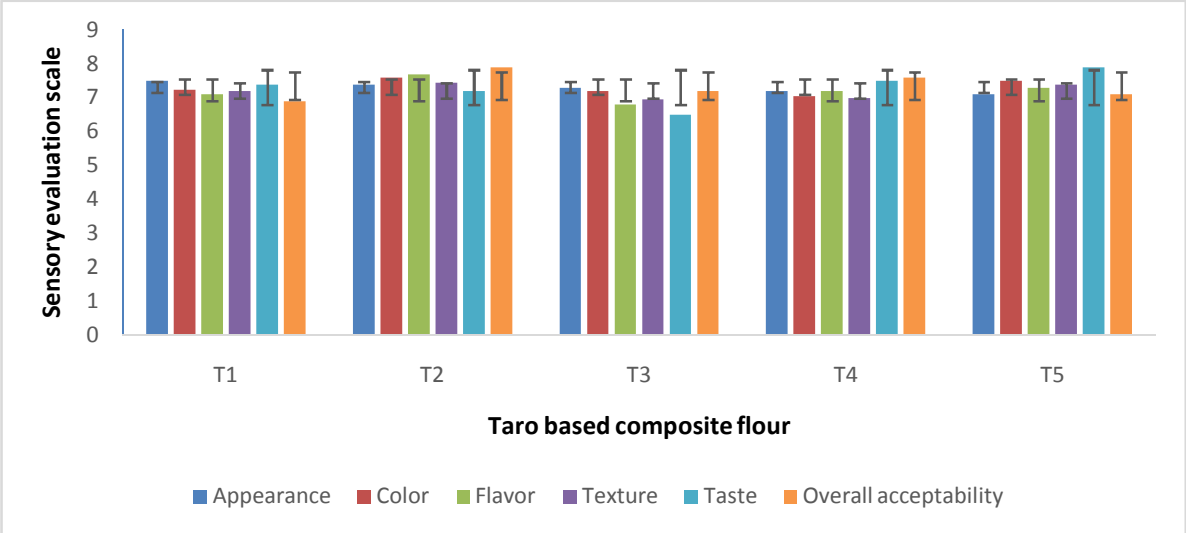

Fig 3. Sensory evaluation of cookies developed from taro based composite flour

STATISTICAL ANALYSIS

The analysis of variance of the data obtained was done by using Completely Randomized Design (CRD) for different treatments as per the methods given by AOAC, 2000 [8]. The analysis of variance revealed at significance of P< 0.05 level, S.E. and C.D. at 5 % level is mentioned wherever required.

CONCLUSION

Flour is a backbone ingredient for development of almost all types of cookies. The desired characteristics for cookie flour include the ability to mix with other ingredients into a homogenous mass with minimal added moisture. This moisture provides good machining properties, control the expansion and spread of dough during baking.From our study, it is clear that composite flour of formulation S3 (60% sweet potato flour, 20% sorghum flour,15% chickpea flour and 5% flax seed) and T2 (70% taro flour, 15% sorghum flour, 10 % chickpea flour, 5% flax seed flour) were found to be highly acceptable with high overall acceptability scores compared with other formulation of cookies. The physical changes in the developed cookies varied significantly but the results showed a decreasing trend in the spread ratio of the developed cookies of sweet potato and taro based composite flour which may be attributed to the differences in swelling patterns and rheological properties. The sensory attributes evaluated in sweet potato based cookies showed significant difference. In case of taro based cookies no significant difference ($p < 0.05$) in the sensory attributes of appearance, color, flavor and texture but in terms of taste and overall acceptability it varied significantly. The results vividly showed that it could be possible to produce nutritious and acceptable cookies through tuber crops based composite flour. These nutrient dense cookies can play an effective role in bringing down malnutrition. Thus, the production of these cookies at a commercial level will provide a good opportunity for entrepreneurship development.

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