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Research Article

PHYSIOCHEMICAL AND SENSORIAL PROPERTIES OF BISCUITS PREPARED FROM ELEPHANT APPLE POWDER BASED COMPOSITE FLOUR

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Abstract- In present investigation, biscuits were prepared from elephant apple powder (EAP) with 5, 10 &15 % along with control for comparing physical properties, chemical composition, color values, texture values and sensory response acceptability. The food value of the biscuit as determined through nutrient analysis-moisture (4.19%), protein (7.60%), fat (30.11%), ash (1.66%), dietary fibre (9.25%) and carbohydrate (56.08%)with 10% of EAP was comparable to control (refined wheat flour) biscuit. The color values (L*, a* & b *) of the biscuits with 10% EAP were found as 49.91, 8.34 & 30.78, respectively. Sensory response of the EAP biscuits revealed the significant reduction with the addition of powder. In conclusion, addition of 10% EAP biscuits was acceptable with respect to nutritional and sensory scores that may help to fulfill the daily nutrient requirements.

Keywords- Elephant Apple Powder, Proximate Analysis, Color Values, Texture, High Fiber Biscuit.

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Introduction

Elephant apple (*Dillenia indica*) an underutilized fruit is a species of Dillenia, is largely available in eastern and northeastern India. The plant parts leaf, bark, and fruit have been used in the traditional medicine as they are having good therapeutic values [1]. Major contents of the fleshy sepals are tannins, malic acid, and glucose. They also contain an arabinogalactan, betulin, betulinic acid and flavonoids [2]. The fruit is indigenously used in Ayurveda to treat nervousness, abdominal distress and fatigue [3]. Various part of the elephant apple have extensive medicinal values like Antimicrobial [4, 5], Antioxidant [5, 6] and Anti-diabetic [7].

India is a major business house for bakery goods and is the third largest biscuit manufacturing country after USA and China. The bakery products (biscuit) from the major baked foods responsible for over 82% of total bakery products produced in the country reported by MOFAI, 2015[8]. Biscuits are ready-to-eat food product that is consumed among all age groups in many countries. It has been informed that replacing wheat with 20% non-wheat flour for the manufactured of bakery products would result in an estimated saving of USD $ 320 million annually [9]. There are number of fruits that can be considered as functional ingredients to be combined in product's formulation such that it will improve the final quality of the biscuits like crispiness, spreading ratio and crunchiness as well as to harvest healthy food product which may provide good nutritive value to consumer still a challenge among the bakery manufacturers[10].

The rheological properties of the dough (a thick, malleable mixture of flour and liquid, used for baking into biscuit) is very important as it influence the textural properties of the dough [11, 12].

There are previous studies that had been done to enhance the nutritional quality of biscuits by utilizing different composite flour from various types of food sources in biscuits [13]. The utilization of elephant apple powder (EAP) in bakery products (biscuits), has not been reported till time. An approach in the present study was to replace wheat flour partially with elephant apple flour (gluten free flours)in order to increase the fiber and other nutrients in biscuits. Second objective of this study was to evaluate the effect of replacement of wheat flour with different levels of EAP on dough rheological properties, nutritional value and sensory properties of the biscuit.

MaterialsandMethods

Materials

Fresh elephant apples (*Dillenia indica*) were purchased from Kokrajhar local market. The fruits were washed thoroughly and sepals were separated using the semi-automated self-designed cutter and sliced at a uniform thickness of 2 mm. The slices were spread uniformly over the trays as a thin layer (stainless steel mesh wire) and dried using vacuum dryer at 60 °C and a pressure of 30 kPa. Final dried sample were milled through a 150-micron mesh using hammer mill (Model L-32, K. C. Engg, Ambala, India). The milled extract (Elephant apple power/EAP) was stored in a sealed plastic container at a cool, dry shelf-prior to use.

Preparation of biscuit

The biscuits were made in the Bakery Oven (Macro Scientific works pvt. Ltd, New Delhi, India) at Bakery and Food Analysis Lab, Central Institute of Technology, Kokrajhar using the standard recipe consisting of wheat flour 100g, 50g of sugar , 60 g of fat, sodium bicarbonate 0.5 g, custard powder 2 g [14]. For the trials, biscuits were prepared by substituting wheat flour with elephant apple powder at three different levels viz. 5, 10 and 15% (w/w) in the standard formulation. Baking was carried out at 1800C for 15 min.

Physiochemical analysis

Physical properties of biscuits such as of diameter, thickness, weight and volume were determined by (AACC, 1995) [15].Proximate composition (moisture content, Ash, crude fat and dietary fiber) was determined by using AOAC methods [16].

Color measurements

Colour was measured at three predetermined places of the dietary biscuits top and bottom surfaces using a Hunter colorimeter (D25 LT, Hunterlab, USA). The instrument was calibrated with a regular white tile (L = 90.55, a = -0.71, b = 0.39). The L* value is the degree of lightness, a* value is the degree of redness (+) and greenness (-), and b* value is the degree of yellowness (+) and blueness (-) as described by Hutchings et al., 2002[17].

Texture

Texture profile of biscuits was measured using at exturo meter Texture Analyser (TA.XT Plus, Stable Microsystems, Surrey, UK). Calibration was carried out with the aid of a 25 kg load cell. The probe used was a HDP/BS with pre-test speed of 1.5 mm/sec and the test speed was 1 mm/s. Hardness was calculated from the force/time curves obtained (TPAs) [18].The measurement of each sample was done in triplicate.

Sensory analysis

For sensory evaluation, 25 untrained volunteers were selected. For the sensory analysis (odour, taste and overall acceptability), the judges rated the preferred sample in assessment with the 0% EAP biscuit as control. Acceptability as a composite of odor and taste was assessed using a scale ranging from 0 to 9. The scale points were: like extremely-9, like very much-8, like moderately-7, like slightly-6, neither like nor dislike-5, dislike slightly-4, dislike moderately-3,dislike very much-2, dislike extremely-1.

Statistical analysis

The data were obtained from independent experiments with repetition, and the means were obtained from the triplicates. Mean values were compared by analysis of variance (ANOVA) using the SPSS software (version 13.0).

Results and Discussion

Physical properties

The biscuits prepared using 0, 5, 10 and 15 % level of incorporation of EAP were evaluated separately for various physical parameters [Table-1]. The weight of the biscuits increased with the addition of EAP due to increase in the density of biscuits [19]. The diameter of biscuits also increased with the addition of EAP and thickness of the biscuits did not show any variation. This is reflected in the values of the spread ratio, which increased from 5.24 in control sample to 5.26, 5.33 and 5.39 in the case of EAP 5%, EAP 10% & EAP 15%, respectively. This is may be due to dilution gluten and disruption of gluten protein matrix. These results are in agreement with earlier studies carried out by Jyotsna et al. (2012) [20] for green gram incorporated biscuits and Crassina et al. (2012) [21] for finger millet flour biscuits.

Table-1 *Physical properties of EAP Biscuits*

Biscuits	Weight (g)	Diameter(cm)	Thickness (mm)	Spread ratio
Control	8.23	3.21	53	5.24
5% EAP	8.45	4.02	52	5.26
10% EAP	8.69	4.25	53	5.33
15% EAP	8.42	4.28	52	5.29

Proximate analysis

The proximate composition for biscuits prepared with different ratios of elephant apple powder (5%, 10% and 15%) was given in [Table-2]. The values in the [Table-2], shows that fat content of biscuits with different levels of EAP were varied slightly and it was within 29.97 to 32.55 % when compared to the fat content of control biscuits (32.55 %). The ash content of biscuits were not varied significantly and it was within the levels of 1.44 (control) to 1.83 %. A significant difference was observed in moisture, dietary fiber, carbohydrate and protein content of control and biscuits with EAP. Moisture content of the biscuits was varied from 3.25 (control) to 4.33 (biscuit with 15% EAP). Higher carbohydrate level was observed in control biscuits (60.21%) and lower level was detected in biscuits with 15% EAP (52.11%). Dietary fiber content was varied from 8.22 (control) to 10.11 % (biscuit with 5%EAP). Biscuits with 15% EAP had higher protein level (8.94%) and control samples showed lower protein level (2.36).The increase in moisture content can be attributed due to the increased protein content that also increases the water binding capacity of dough with higher levels of EAP. It is also reported that with the addition of mustard flour moisture content of biscuits increased slightly [22]. Similarly, increasing levels of millet flour in soy millets biscuits resulted in an increase in moisture content [23]. Thus it can be concluded that fortification had a positive effect on overall nutritional quality of biscuits since proteins and ash increased significantly as shown by the statistical analysis.

Table-2 *Proximate analysis*

Biscuits	Moisture	Ash	Crude fat	Carbohydrate	Protein	Dietaryfiber
Control	3.25	1.44	32.55	60.21	2.36	8.22
5% EAP	4.01	1.53	31.06	56.42	5.98	10.11
10% EAP	4.19	1.66	30.11	56.08	7.6	9.25
15% EAP	4.33	1.83	29.97	55.11	8.94	9.62

Color analysis

The CIE color values of biscuits with/without EAP was shown in [Table-3].All color values (L*, a*, b*) were differed in between the test samples and also to the control samples. The color values (L*, a*, b*) of the control sample was recorded as 64.15, 27.32 & 53.57 respectively. The L*,a*, b* values of test samples was varied between 40.23 to 49.91, 8.34 to 11.93, 26.58 to 30.78 respectively. Biscuits with 10% EAP showed higher L* and b* values and lower a* values. Biscuits with 5% EAP showed higher a* values and biscuits with 15 % EAP showed lower L* and b* values.

Texture analysis

The textural parameters are one of the most important quality attributes, which affects the overall quality, and hence demand of biscuits. The instrumental textural profile analysis is conducted to confirm and improve the textural properties as obtained from subjective evaluation of texture. The textural parameter i.e. hardness (N) was represented in [Table-3]. A decreasing trend was observed for hardness when increasing the EAP levels up to 15%. The values were found to be varied from 4.442 to 5.535 N and the control samples showed the hardness value of 5.682. From the results it can be seen that the EAP incorporated biscuits were less hard than the control biscuits.

Table-3 *Color and harness of the biscuits*

Biscuits	L	a	b	ΔE*	Hardness (N)
Control	64	27	53		5.682
5% EAP	49.41	11.93	30.18	59.12	5.535
10% EAP	49.91	8.34	30.78	59.22	4.838
15% EAP	40.23	8.61	26.58	63.18	4.442

Sensory analysis

The effect of increasing EAP levels on sensory parameters of biscuits were depicted in [Table-4]. Consumer panel sensory scores of biscuit appearance and color were not significantly different from the control [Table-4]. The statistical analysis showed that there were a slight variations in all other sensory parameters i.e. flavor, texture, taste and overall acceptability on substitution of EAP (up to 15%) compared to control. For all the parameters, the scores given by panelists were found in the range of 6.71 to 7.98, which is quite an acceptable range. Consumer acceptance regarding flavor, texture, taste and overall acceptability was significantly ($P<0.05$) higher for biscuits prepared from control and 5% EAP versus those prepared with 10% and 15% EAP addition. As the level of EAP increases, the scores for biscuit sensory properties decreased accordingly.

Overall acceptability scores also following the same trend as like the individual sensory parameters. Biscuits with 5% EAP were more acceptable in or ganoleptic evaluation. The sensory properties of cookies made with corn gluten meal fortification was studied and reported that cookies with good aroma and crispiness could be prepared with flour blends having EAP level at levels as high as 10% [24]. In another study [25], cookies made with 15% supplementation of defatted wheat germ flour in wheat flour showed sensory scores in the acceptable range.

Table-4 *Sensory analysis of the biscuits*

EAP levels (%)	Appearance and Color	Flavour	Texture	Taste	Overall Acceptability
0 (control)	7.97	7.95	7.89	7.98	7.95
5	7.31	7.21	7.16	7.34	7.27
10	7.05	6.85	6.82	7.09	6.86
15	6.84	6.71	6.74	6.82	6.57

Conclusion

The addition of EAP resulted in significant increase in protein content in wheat flour-EAP blends. From the above investigation, it can be concluded that although biscuits incorporated with 15% replacement of EAP were nutritionally rich they received lower score for different sensory attributes than the ones prepared from 10%. The textural properties showed that the hardness of biscuits was decreased with increase in EAP incorporation level up to 15%. Incorporation of EAP had a significant effect on color values, a* values were decreased while 'L*' and 'b*' values increased up to 10% EAP levels and then decreased for 15% EAP incorporation by producing a darker color with higher levels of EAP. The results obtained could be very valuable in decision making for industries that want to take nutritional advantage of EAP as alternative or supplement to wheat flour. EAP could be useful in the manufacture of highly nutritious biscuits.

Conflict of Interest: The authors declare that there are no conflicts of interest.

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