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Waste Utilization of Amla Pomace and Germinated Finger Millets for Value Addition of Biscuits

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Abstract

Fiber and vitamin C rich food plays an important role for human health. The aim of this study was to prepare the fiber and vitamin C rich biscuits and to quantify the levels of fiber, protein, fat, and vitamin C in prepared amla pomace biscuits. The fiber content of biscuits ranges from 1.7-5.2 % and the maximum fiber was obtained for biscuits prepared from 15 % amla pomace. The fat content of biscuits varies from 14.03-18.03% and the manimum fiber was obtained for biscuits prepared from 15 % amla pomace. The prepared biscuits are rich in Vitamin C which increases with increase in pomace concentration and varies from 26.28-49.15 mg/ 100 gm. The ash content of biscuits ranges decreases with increased concentration of pomace and protein content varies from 7.27-7.52 %.

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Finger Milltes;
Germination;
Pomace;
Value Addition.

Introduction

Nowadays, there is great need to reduce the industrial pollution. Almost all countries are adapting this reality and trying to modifying their processes in order that the obtained residues may be recycled one.[1] Most of the fruit is cultivated for table purpose but apportion of fruit harvested is being processed into numerous products like fruit juice to a bigger extent and also the by-product obtained after juice extraction is termed as fruit pomace which is a waste material with good nutritive value.[2] It has been found that after juice extraction about 25 % of the fresh fruit is lost in the form of fruit pomace.[3] In the past, fruit pomace after drying was used as animal feed. Although, the fruit pomace is a waste but it is a good source of dietary fibres, carbohydrates, minerals, vitamin C and high moisture content.[4] The fruit pomace contains 14-30% of crude fiber of the dry weights. Fruit fiber also contains higher amount of TDF (Total Dietary Fibers) as compare to wheat

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and oat bran. It acts as humectants in certain food products and it has good water holding capacity.[5]

Amla fruits (*Emblica officinalis*) are in use since from traditional Indian system as medicines because of its therapeutic value. Amla is a rich source of ascorbic acid (vitamin C) and it also contains tannin, polyphone, pectin, gallic acid and fibre. It is used as a medicine to treat common colds, gastric troubles, constipation, enlarged liver headache, etc. They also play different roles in our human body such as to clean blood, reduce cholesterol and provide energy to heart, brain, and liver and also in the diagnosis of diarrhea.[6,7]

Finger millet (*Eleusinian Caracara*) is an important staple food in some parts of India.[8] It contains protein (9.8%), mineral (2.7%), carbohydrate (81.5%) and crude fiber (4.3%). Its crude fiber and mineral contents are higher than wheat which contains 1.2% fiber and 1.5% minerals and also higher than rice which contain 0.2% fiber and 0.6% minerals.[9,10] Finger millet has good quality protein and also contains vitamin A, essential amino acid, vitamin B, and phosphorous.[11] Thus it is a recommended as a good source of diet for expecting women, growing children, old age people and patients. It also controls the blood glucose levels in diabetic patients.[12] Instead of the high nutritional properties of finger millet, still it is only utilized in rural areas at the household level which may be because of lack of novel processing to provide safe and improved foods commercially.[13]

There is wide scope for biscuit because it is long lasting and easily available in market. It can be prepared from different ingredients like refined wheat flour, millets flour, multi-grain flour, soy flour. It contains protein, ash, fats and crude fibre.[14] The biscuits need addition of nutrient content to improve its nutraceutical properties. If the refined wheat flour is supplemented with amla pomace dried powder and germinated finger millet flour then it improves the nutritional quality and sensory attributes of biscuits. In corporation of fibre sources can increase fibre content of the biscuit, but the biscuit made by incorporating these materials cannot provide a good taste and flavour. Incorporation of amla pomace in biscuit increase fiber content as well as sensory attributes of biscuit.[15]

The present study addresses the enhancement of vitamin C and fiber by utilizing amla pomace and protein by utilizing germinated finger millets in biscuit preparation. The aim of the study is to investigate the effect of pomace and germinated millets concentration of the formulated biscuits on quality attributes.

Material and Method

Material

Fresh amla fruit (*Emblica officinalis*.) and finger millet (*Eleusinian Caracara*) were procured from the local market of Dehradun. On the basis of visual inspection the amla fruit is procured to select fruits having no defect. These selected fruits were then cleaned and washed by removing damaged fruits and finger millets were cleaned by removing all foreign matters manually.

Preparation of Amla Pomace Powder

Juice was extracted from amla (*Emblica officinalis*) to obtain amla pomace using juicer grinder. Amla pomace was then blanched in boiling water at 80 ± 2 °C for 3 min to stop the activity of enzymes and growth of other microorganism to store pomace for further use16. It was then cooled immediately by exposing it in air and dried at 60 ± 2 °C in tray

Table 1: Experimental plan for biscuit preparation

Sample. No.	Amla pomace (%)	Finger millet flour (%)	Refined wheat flour (%)
1	0	0	100
2	7.5	10	82.5
3	10	10	80
4	12.5	10	77.5
5	15	10	75

drier.[17,18] Dried amla pomace was ground to fine powder to pass through 40 mesh sieve and packed in for further use.[16]

Germination of Finger Millets

The finger millets were washed by using normal tap water. Then, the washed grains were soaked in water (3:1) at room temperature of 25±1°C for 24 hours. It was then germinated at 30°C for 48 hours and dried in a cabinate dryer at 60°C and then packed in airtight polyethylene bags for further use.[19,20,21]

Preparation of Biscuits

The biscuit was prepared by mixing all ingredients in proper ratio, sugar (50 gm), butter (40 gm), baking soda (1.5 gm), baking powder (1.5 gm) and baked it at 170°C for 15-20 min.[22,23] The prepared amla pomace biscuits were packed in polyethylene bags and stored at room temperature in air tight condition for further analysis. The experimental plan is shown is Table.[16,24]

Functional Properties of Flours

The oil and water absorption capacity was determined by mixing 1g of sample with 10 ml of refined soybean oil or distilled water. It was then kept at ambient temperature for 30 min and centrifuged at 5000 rpm for 10 min. The both were then expressed as percent water or oil absorbed per gram of the sample.[25]

Physical Analysis

The prepared biscuits were analyzed on the basis of change in width, thickness, spread factor, density, volume, baking weight loss and hardness.[26] The diameter was measured by placing three biscuits horizontally (edge to edge) and rotating it at 90° angle for reading by using vernier calliper. Thickness of biscuits (T) was also measured by vernier caliper in triplicate and means were recorded. Spread ratio (SF) was calculated by the following formula, SF = D/T. Volume (V) was calculated by, $V = (D^2 \pi T)/4$. Density was calculated by following formula, Density = Mass/Volume. Hardness of the biscuits

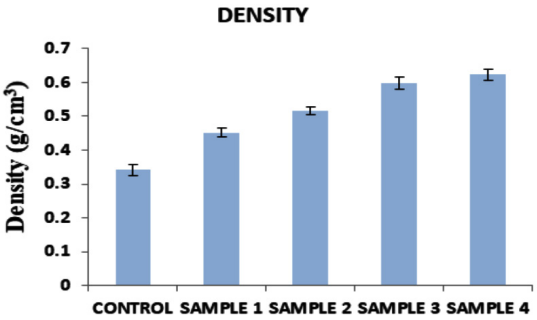

Fig. 1: Change of density in samples

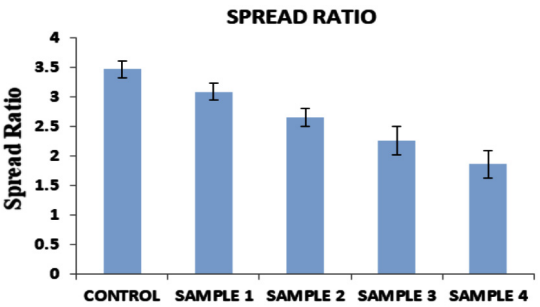

Fig. 2: Change of Spread Ratio in Samples

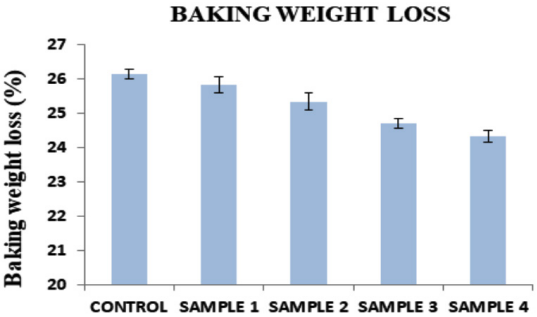

Fig. 3: Variation of banking weight loss in samples

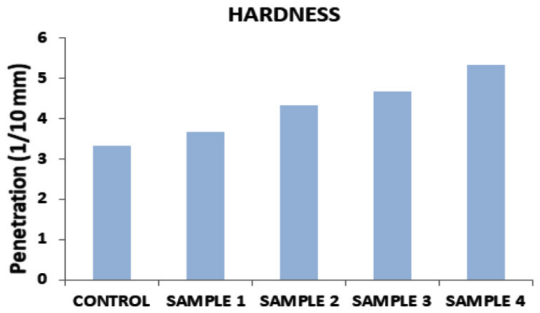

Fig. 4: Variation of hardness in samples

was tested by Peneterometer in triplicates. Hardness was measured on the basis of penetration of needle into the biscuit and then the mean was taken. Baking weight loss (BWL) was determined by measuring the biscuit weight before and after baking. It was calculated according to the equation, BWL (%) = $(m_0-m_t)/m_0 \times 100$. Where, m_o = initial biscuit weight (g) and m_t = weight (g) after baking time t (min).[7,27]

Chemical Analysis

Moisture content was measured by hot air oven drying method by keeping 10 g of sample in oven at 105 ± 2 ºC for 2 hr.[28] Protein content in grains was determined using Bradford method.[29] Fat content in food was determined using soxhlet extraction method.[30] The crude fiber content in sample was estimated using AACC method.[31] Total ash content was determined by AOAC method.[30] Carbohydrate content was estimated by difference method. Energy was calculated by the given formula: Energy = carbohydrates × 4 + fat × 9 + protein × 4. Vitamin C was calculated by titration method.[32]

Statistical Analysis

The experiments were replicated three times and represented as the average of triplicate observations. It was then analyzed statistically by using one factor analysis of variance in excel sheets.

Result and Discussion

Functional properties of Raw Material

The refined wheat flour has significantly higher ($p < 0.05$) water absorption capacity (WAC) (148.2%) than finger millet flour. The oil absorption capacity (OAC) ranged from 161.1 to 167.3% and refined wheat flour showed greater OAC.

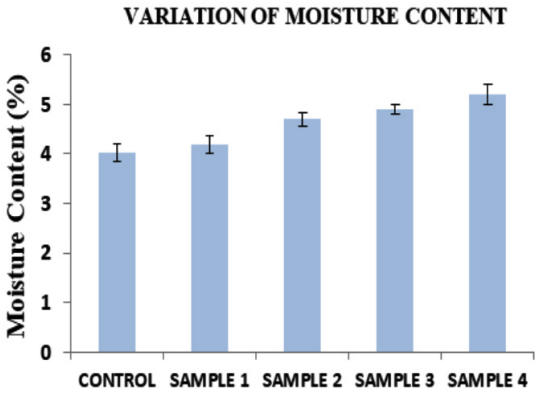

Fig. 5: Variation of moisture in samples

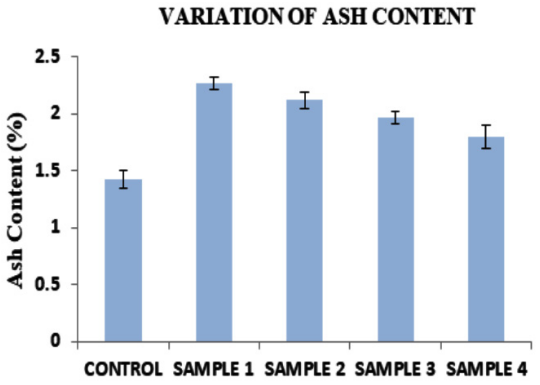

FIg. 6: Variation of ash in samples

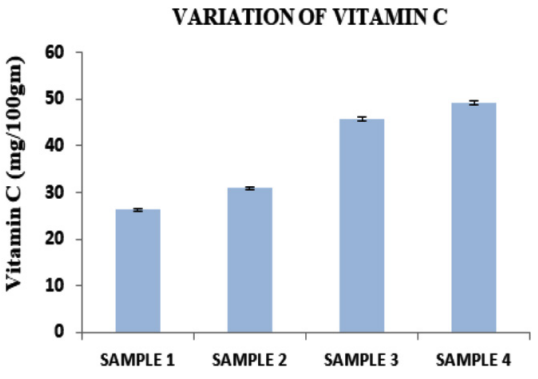

Fig. 7: Variation of vitamin C in samples

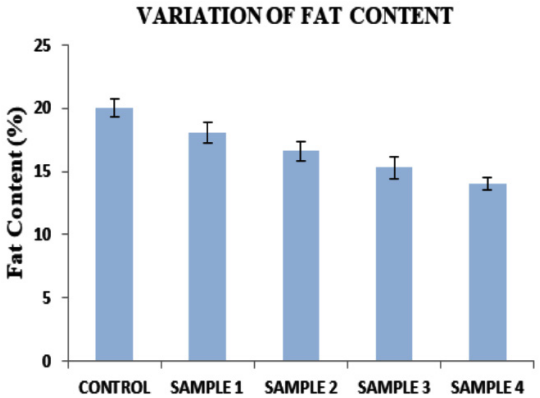

FIg. 8: Variation of fat in samples

Physical Properties of Biscuits

The density of biscuits was more before baking as compare to the density of the biscuits after baking. It was because of increase in volume of biscuits after baking and because of baking weight loss. The change in density ranges from 0.452 – 0.623 g/cm^3 which is higher than the control biscuits (0.343 g/cm^3). This change in density increases significantly ($p<0.01$) with increase in pomace quantity (Fig. 1). The spread ratio of biscuits decreases after baking. It was because of increase in thickness of biscuits after baking. The change in spread ratio ranges from 1.87 - 3.09 which is lower than the control biscuits (3.48). This change in spread ratio decreases significantly ($p<0.01$) with increase in pomace quantity (Fig. 2). The baking weight loss ranges from 24.33 - 25.81 % which is lower than the control biscuits (26.14 %). This baking weight loss decreases significantly ($p<0.01$) with increase in pomace quantity (Fig. 3). The hardness of biscuits increases significantly ($p<0.05$) with increase in pomace concentration (Fig. 4). It ranges from 0.36 - 0.53 mm which is higher than the controlled biscuits (0.33 mm).

Proximate Composition of Biscuits

The moisture content of the biscuits ranges from 4.2 to 5.2 % which is significantly higher ($p < 0.01$) than the control biscuit (4.02 %). It was found that the moisture content increases with increase in pomace quantity in the biscuits. There is 4.56 to 29.46 % increase in moisture content of biscuits from controlled biscuits (Fig. 5). The ash content of biscuits ranges from 1.8 - 2.27 %, which is significantly higher ($p < 0.01$) than control biscuit

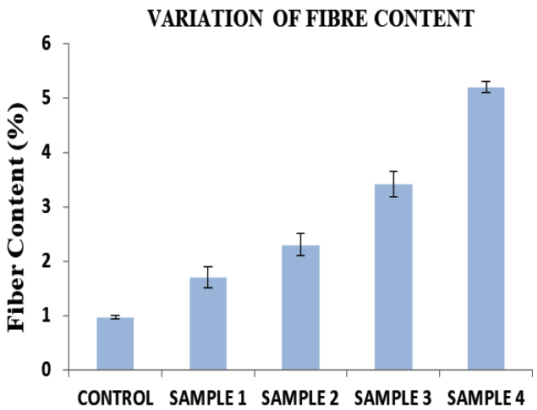

Fig. 9: Variation of crude fiber in samples

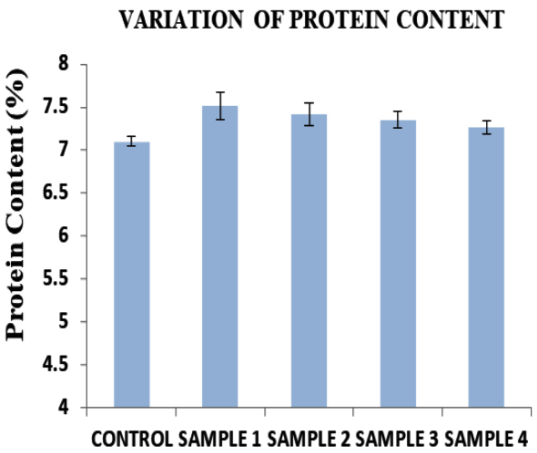

FIg. 10: Variation of protein in samples

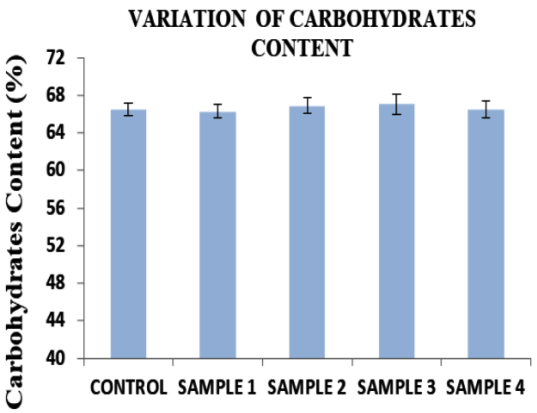

Fig. 11: Variation of carbohydrates in samples

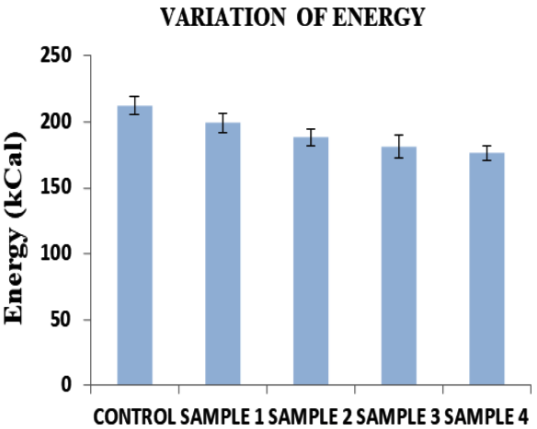

FIg. 12: Variation of energy in samples

(1.42 %). It was found that as the pomace content increase the ash content decreases (Fig. 6). Ash content increases from 26.46 to 59.25 % from the controlled biscuits. The vitamin C content of biscuits varied highly significantly ($p < 0.01$) and it ranged from 26.28-49.15 mg/100gm. The increase in vitamin C content of biscuits was observed with increase in concentration of pomace in the biscuits (Fig. 7). It may be due to high Vitamin C content of amla pomace powder. The fat content of the biscuits varied highly significantly ($p < 0.01$) which it ranges from 14.03-18.03 % which is lower than the controlled biscuits (20%). The decrease in fat content in the biscuits was observed with increasing extent of substitution as it may be due to low fat content of substitution (Fig. 8). Fat content decreases from 9.83 to 29.83 % from the controlled biscuits. Fiber content ranges from 1.7-5.2% which is higher than controlled biscuits (0.969%). The fiber content of biscuits varied highly significantly ($p < 0.01$). It was observed that as the pomace content increases the crude fiber also increases (Fig. 9). It is due to the high fiber content of the pomace. The fiber content increases from 75.32 to 436.26 % from the controlled biscuits. The protein content of biscuits ranges from 7.27-7.52 % which decreases highly significantly ($p < 0.01$) with increase in pomace concentration (Fig. 10). The protein content of biscuits increases from controlled biscuits from 2.30-5.82 %. The carbohydrate ranges from 66.28-67.07 % and its variation in not significant (Fig. 11). The energy level of biscuits ranges from 176.17-199.17 kcal (Fig. 12) and it decreases significantly with increase in pomace concentration ($p < 0.01$).

Conclusion

The findings of the present research can be utilized in the development of high protein and fiber rich biscuits. The studies have showed that incorporation of germinated finger millet flour and amla pomace produce the value added biscuits of good quality. The fiber, protein, vitamin C and ash content of biscuits increases with addition of pomace and germinated finger millet flour. The fiber and Vitamin C content of biscuits increases with increase in pomace concentration in the biscuits. The protein and ash content of biscuits are higher than the controlled biscuits. The fat content of biscuits decreases with increase in pomace concentration.

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