DEVELOPMENT AND ACCEPTANCE ANALYSIS OF MIXED FRUIT POMACE FORTIED HIGH-FIBRE BISCUITS

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Abstract— Core fruit product processing industries generate and discard a large amount of pomace of various fruits on daily basis. This discarded pomace is a very rich source of natural dietary fibres which acts as a laxative and helps in lowering weight through proper bowel movements, lowers blood sugar level and prevents colon and rectum cancer. But due to the processing errors and natural characteristics of pomace, it cannot be directly consumed. Hence, its incorporation into food to prepare high fibre products holds tremendous potential. Looking at its commercial as well as preservation prospect, this study was carried out where pomace of four fruits (apple, orange, grapes, and pineapple) were minimally treated to form powder, incorporated in biscuits by replacing portions of flour and the level of fortification was judged based on physico-chemical analyses. While one part of the study checked for the effect of baking time (10, 15, 20 minutes) and temperature (150°, 200°, 250° C) at different fortification levels (5%, 10%, 15%, 20%) through checking impact on the physical parameters of the biscuits compared to control followed by shelf life studies; the other part of the study involved sensory evaluation of different levels of fortification made through standard baking procedure (Temperature: 160° C and Time: 20 minutes) to check for acceptance and comparative analysis of analytical parameters viz. Moisture, Protein, Fat, Fibre, Peroxide value & Ash taking both blanched and unblanched pomace powder. Results show that, different baking time and temperature do not have much effect on the biscuits of different fortification level; only spread ratio reduces in case of low time and high temperature combination. Sensory evaluation reveals the acceptability of 15% fortification is highest. In case of shelf-life, after 40 days, the moisture increases while protein is analysed to decrease.

Keywords— Fruit Pomace, Dietary Fibre, Fortification, Biscuits, Acceptance Analysis.

I. INTRODUCTION

Dietary fibre, also known as roughage or bulk, includes all parts of plant foods that your body can't digest or absorb. Unlike other food components, such as fats, proteins or carbohydrates — which our body breaks down and absorbs — fibre isn't digested by our body. Instead, it passes relatively intact through stomach, small intestine, colon and out of body. Chemically, dietary fibre consists of non-starch polysaccharides such as arabinoxylans, cellulose, and many other plant components such as resistant starch, resistant dextrins, inulin, lignin, waxes, chitins, pectin's, beta-glucans, and oligosaccharides. The term "fibre" is something of a misnomer, since many types of so-called dietary fibre are not actually fibrous. Advantages of consuming fibre are the production of healthful compounds during the fermentation of soluble fibre, and insoluble fibre's ability (via its passive hygroscopic properties) to increase bulk, soften stool, and shorten transit time through the intestinal tract.

The experiment was conducted to develop of mix fruit pomace (apple, orange, grapes, and pineapple) fortified biscuits and to check the physical parameters of biscuits at different pomace concentration and time-temperature combination followed by acceptability study as well as quantitative analyses of biscuits with different levels fortification baked at a standard time-temperature combination.

II. MATERIALS AND METHOD

The study was conducted at the Department of Food Technology, ITM University, Gwalior. Fresh fruits of local varieties (apple, pineapple, grapes and orange) and good quality refined flour were procured from the local market of Gwalior. Proper care was taken to avoid spoiled/damaged/unacceptable raw materials while purchasing the fruits.

2.1 Preparation of mixed fruit pomace powder

Fresh fruits (apple, pineapple, orange, grapes) were washed to remove dust and microbes; juices were extracted from these fruits by using suitable juicer to obtain fruit pomace. After blanching the pomace at 80 0C for 3 min immediately cooled by exposing to air and dried in tray drier at 60 0C until 98% moisture was lost. Dried pomace were grinded to make a fine powder, sieved using 40 mesh sieve and packed in air tight containers.

2.2 Procedure for Dough Enriched with Dietary Fibre

The mixed fruit pomace powder was incorporated in the standardized recipe of biscuit in 5, 10, 15 and 20 % proportion with flour with slight modification of standardized process. Mixed fruit pomace powder and baking powder were mixed with wheat flour (maida) and were sieved two to three times. Sugar powder is added in margarine mixture to prepare cream followed by addition of pomace mixed flour and water was added as per requirement to form soft dough. Flat sheet (0.4 cm) was prepared using dough sheeter. Biscuits were stamped out using stamping

method. Trays with raw biscuits were kept in the baking oven for 20 min at temperature 160°C (taken as standard) and observed changes during baking. After complete baking it was cooled upto 45 0C and packed in low density polyethylene packs (LDPE).

2.3 Physical parameter analysis

Physical properties of mix fruit pomace fortified biscuit includes diameter, thickness, spread ratio, percentage spread factor, volume and density. Five readings for sample with five replications were done using following methodologies and formulations:

2.3.1 Spread ratio of biscuit

To find thickness five readings for each sample, five replications were done.

$$\text{Spread ratio} = \frac{\text{Diameter of biscuit}}{\text{Thickness of biscuit}}$$

2.3.2 Volume of biscuit

Volume of biscuit is defined as the area of the biscuit multiplied by thickness

$$\text{Volume}\left(\frac{g}{cm^3}\right) = \frac{d^2 \times \pi \times T}{4}$$

where,
T= thickness of biscuit (average) (cm)
d= diameter of biscuit (cm)

2.3.3 Density of biscuit

After calculating volume, density of biscuit is obtained by ratio of weight to volume.

$$\text{Density}\left(\frac{g}{cm^2}\right) = \frac{\text{Mass of sample (gm)}}{\text{Volume of sample (cm}^3\text{)}}$$

2.3.4 Percentage spread factor

It is defined as the ratio of spread ratio to ratio of control biscuit

$$\%\ \text{Spread Factor} = \frac{\text{Spread ratio of biscuit}}{\text{Spread ratio of control biscuit}} \times 100$$

2.4 Chemical analysis

2.4.1 Moisture Content

Moisture content of the dough sample was determined by using hot air oven method (AOAC, 2005). The dough sample was kept in the hot air oven at 95+ 5°C for 24 hr. initial and final weight of the sample was noted by an electronic weighing balance (make: Precisa, model XB 120A) to an accuracy of 0.001gm.

$$\text{Moisture content (wb)} = \frac{W_2 - W_1}{W_2 - W_3} \times 100$$

$$\%\ \text{Moisture (db)} = \frac{\text{Moisture Content (wb)}}{100 - \text{Moisture Content (wb)}} \times 100$$

2.4.2 Ash Content

Ash content was checked using silica crucibles and muffle furnace as per AOAC, 2005 method.

$$\%\ \text{Ash} = \frac{W_2 - W_1}{\text{Wt. of sample}} \times 100$$

where,
W2-W1= Ash content of sample

2.4.3 Peroxide Value

Peroxide value is a measure of the peroxide contains in a sample of fat, expressed as milli equivalent of peroxides present in per 1000g of sample. Weight 5gm of sample in 250 ml stoperred conical flask, add 30 ml of glacial acetic acid chloroform solution (3:2) and dissolved it. Add 0.5 ml of potassium iodine solution and keep it 1 min. add 20 ml of water and titration against 0.01N sodium thiosulphate solution till yellow colour disappeared by using starch indicator (AOAC, 2005).

$$\text{Peroxide value} = \frac{S - B \times N \times 1000}{W}$$

where,
B = Blank titer value (ml)
S = Sample titer value (ml)
N = Normality of Na
W = Weight of sample

2.4.4 Protein content

Protein can be determined by Kjeldhal's method (AOAC, 2005).

$$\text{Nitrogen (\%)} = \frac{(B - S) \times N \text{ of NaOH} \times 1.4}{W}$$

Empirical factor = 5.8

2.4.5 Fat content

Fat content was found by Soxhlet extraction apparatus by AOAC (2005) method.

$$\text{Fat content (\%)} = \frac{M_1 - M_2}{W} \times 100$$

where,
M1 = Initial wt. of round flask
M2 = Final wt. of flask + Fat
W = Weight of sample

2.4.6 Crude fibre content

The fibre content of mixed fruit pomace biscuit were determined by AOAC (2005) method.

$$\%\ \text{Crude fibre} = \frac{\text{Loss in weight}}{\text{Loss in sample}} \times 100$$

2.5 Organoleptic analysis of the product/Sensory evolution

The fresh samples of Pine apple pomace biscuit was subjected to organoleptic evaluation by a panel of faculties and students. The sensory characteristics such as general appearance, flavour, colour, texture and overall acceptability were evaluated. The judges were provided with 9 point Hedonic scale, scorecard suggested by Amerine et al .1965.

III. RESULTS AND DISCUSSION

The experiment was conducted to study the quality analysis and development of mixed fruit pomace (apple, orange, grapes, and pineapple) fortified biscuits. Findings of present study are presented under the following headings.

3.1 Product standardization

The product standardization was done by the panel of judge's with the help of nine point hedonic scale. The data were summarized in the following section. The 4 ratio of wheat flour and mix fruit pomace powder were taken in which best one was selected for further studies. The ratio of Flour: Pomace were taken as 95:5 (T_1), 90:10 (T_2), 85:15(T_3), 80:20(T_4) and the sensory evaluation was done for general colour, taste, flavour, texture and overall acceptability. The result was depicted from the mean sensory score of below mentioned parameters that the fortified biscuit with 85:15 (T_3) ratio had the highest level of fortification scored the best with 8 on a 9 point hedonic scale for overall acceptability (Fig 3.6), the fortified sample had a light brown colour and this increases the appeal of the product, hence the perfect standardized fortified biscuit was prepared.

After that the baking characteristics of the product was studied and the sample were baked at different temperatures (150, 200 and 250 ^{0}C) and time (10, 15 and 20 min) to determine the optimum baking time and temperature for the best baked product.

3.2 Physical parameters of control and mixed fruit pomace biscuits after baking

3.2.1 Diameter and Thickness after Baking

During present investigation it was observed that the diameter of the biscuits remain constant when it was baked at different time and different temperature. Much effect of different treatments (i.e. T_1, T_2, T_3 and T_4) was not observed on the diameter of the baked MFPP (mixed fruit pomace powder) biscuits.

Much effect on thickness of biscuit was also not observed.

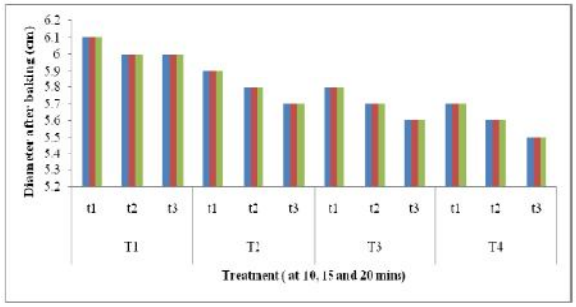

Fig. 1. Diameter after Baking (cm) at treatment time of 10 (t1), 15 (t2) and 20 (t3) minutes (Blue, Red and Green bars stand for 150° C, 200° C and 250° C temperature respectively)

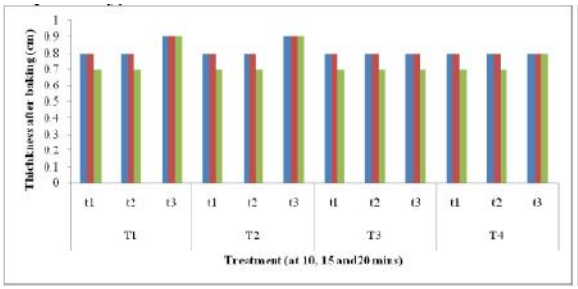

Fig. 2. Thickness after Baking (cms) at treatment time of 10 (t1), 15 (t2) and 20 (t3) minutes. (Blue, Red and Green bars stand for 150° C, 200° C and 250° C temperature respectively)

3.2.2 Spread Ratio after Baking

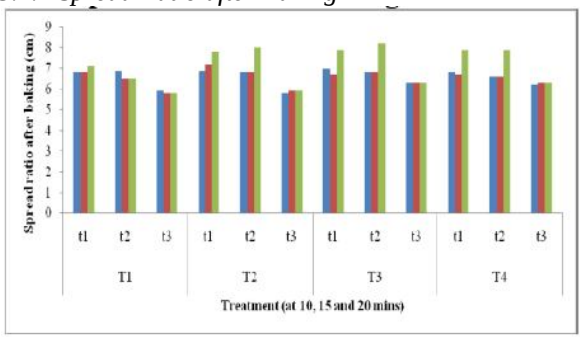

Fig. 3. Spread Ratio after Baking (cm) at treatment time of 10 (t_1), 15 (t_2) and 20 (t_3) minutes. (Blue, Red and Green bars stand for 150° C, 200° C and 250° C temperature respectively)

Only effect was observed on the spread ratio of the MFPP biscuits when it was baked for more than 20 min, spread ratio of the product was high. The spread ratio of the MFPP biscuits was minimum when it was baked for less than 10 minutes. but the rise in spread ratio was observed similar with the increase of baking time, it was also observed that biscuit containing more pomace powder shows less spread ratio, spread ratio was found maximum (8.4) in those 85:15 samples which were baked for 20 minutes at 200 0C . No spread effect of treatment and baking time was observed on volume and density of the pineapple pomace biscuits.

3.2.3 Volume after baking

The volume after baking was found to be highest at T_3 after 20 minutes of treatment time and was found to lowest at T_1 after 15 minutes of treatment time. This is due to the increase in duration of treatment time from 15 minutes to 20 minutes since there was more moisture loss at 160 °C treatment temperature.

3.2.4 Density after Baking

The density after baking was found to be highest at T_3 after 20 minutes of treatment time and was found to lowest at T_1 after 15 minutes of treatment time. This is due to the increase in duration of treatment time from 15 minutes to 20 minutes since there was more moisture loss at 160 °C treatment temperature.

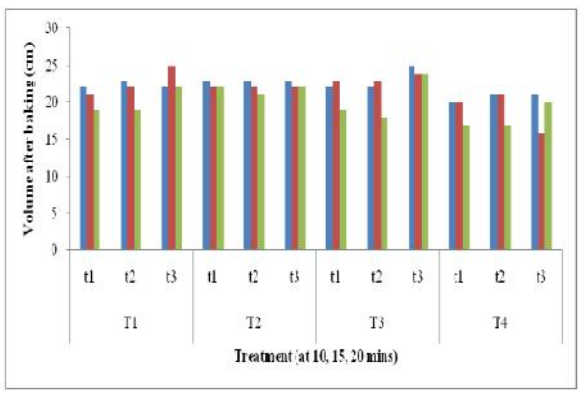

Fig. 4. Volume after Baking (cm) at treatment time of 10 (t1), 15 (t2) and 20 (t3) minutes. (Blue, Red and Green bars stand for 150° C, 200° C and 250° C temperature respectively)

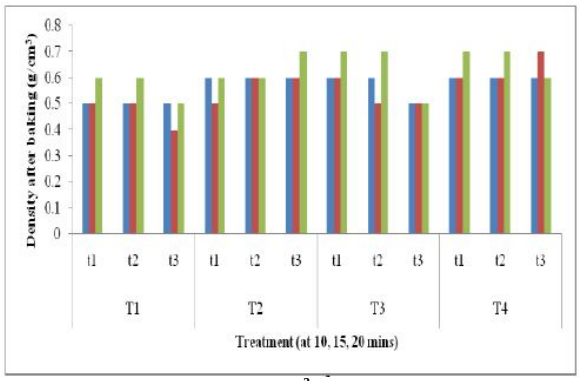

Fig. 5. Density after Baking (g/cm^3) at treatment time of 10 (t1), 15 (t2) and 20 (t3) minutes. (Blue, Red and Green bars stand for 150° C, 200° C and 250° C temperature respectively)

3.2.5 Sensory evaluation for product standardization

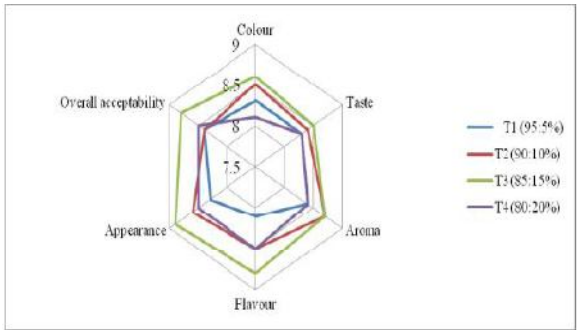

Fig. 6. Sensory evaluation for product standardization by four different treatments of T1 (95:5 %), T2 (90:10 %), T3 (85:15 %) and T4 (80:20 %) for 20 min. baking time and 160°C temperature.

The colour, taste, aroma was found to be lowest acceptable of T4 (80:20 %) and was highly acceptable at T3 (85:15 %). Taste and aroma was found to be lowest at T4 (80:20 %) and T1 (95:5 %) and highly acceptable at T3 (85:15 %). The flavour and appearance was found to be lowest at T1 (95:5 %) and was highly acceptable at T3 (85:15 %). The overall acceptability was found highest at T3 (85:15 %) and was found lowest at T1 (95:5 %).

3.2.6 Quality Analysis of Unblanched Mixed Fruit Pomace Fortified Biscuits.

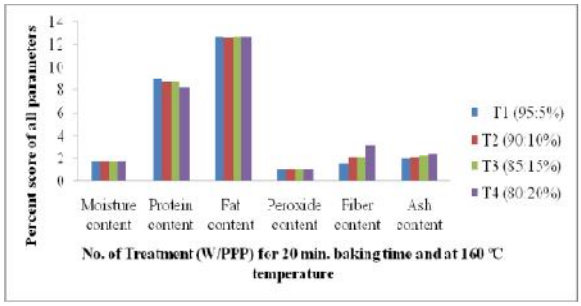

Fig.7. Quality Analysis of Unblanched Mixed Fruit Pomace Fortified Biscuits.

The percentage quality parameters for unblanched mixed fruit pomace fortified biscuits like protein content, fat content, fibre content, ash content was found highest at T1 (95:5 %) and lowest at T4 (80:20 %) for 20 minutes at 160 °C treatment temperature. The percentage quality parameters like fibre content, ash content was found highest at T4 (80:20 %) and lowest at T1 (95:5 %) for 20 minutes at 160 °C treatment temperature. Moisture and peroxide content was similar in all the treatments T1 (95:5 %), T2 (90:10 %), T3 (85:15 %) and T4 (80:20 %). There was a decreasing trend in protein content from T1 (95:5 %) to T4 (80:20 %) as the amount of dietary fibre increased from T1 (95:5 %) to T4 (80:20 %) in unblanched Mixed Fruit Pomace Fortified Biscuits (MFPFB). The ash content also showed an increasing trend from T1 (95:5 %) to T4 (80:20 %).

3.2.7 Quality Analysis of Blanched Mixed Fruit Pomace Fortified Biscuits.

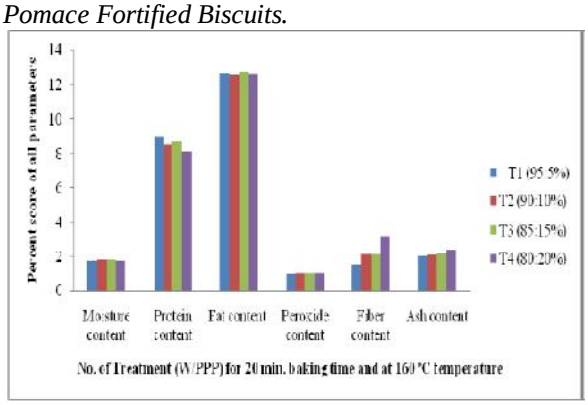

Fig. 8. Quality Analysis of Blanched Mixed Fruit Pomace Fortified Biscuits

The percentage quality parameters for blanched mixed fruit pomace fortified biscuits like protein content, fat content, fibre content, ash content was found highest at T1 (95:5 %) and lowest at T4 (80:20 %) for 20 minutes at 160 °C treatment temperature. The percentage quality parameters like peroxide value, fibre content, ash content was found highest at T4 (80:20 %) and lowest at T1 (95:5 %) for 20 minutes at 160 °C treatment temperature. Moisture content was similar in all the treatments T1 (95:5 %), T2 (90:10 %), T3 (85:15 %) and T4 (80:20 %) and peroxide content similar in all the treatments T2 (90:10 %), T3 (85:15 %) and T4 (80:20 %) except T1 (95:5 %). There was a decreasing trend in protein content from T1 (95:5 %) to T4 (80:20 %) as the amount of dietary fibre increased from T1 (95:5 %) to T4 (80:20 %) in blanched Mixed Fruit Pomace Fortified Biscuits (MFPFB). The ash content also showed an increasing trend from T1 (95:5 %) to T4 (80:20 %).

CONCLUSION

Studies were conducted on incorporation of mixed fruit pomace powder in biscuits and its shelf life studies mixed fruit pomace powder was incorporated with wheat flour in different proportions (i.e. 5%, 10%, 15% and 20%). Physical parameters of control and mixed fruit pomace fortified biscuits were also analyzed before and after baking, and on the basis of

study following findings were drawn. It was observed that the diameter of the biscuit remains constant irrespective of different time-temperature combination and different concentration of incorporation. Similar observations were seen in case of thickness of the biscuits. The spread ratio of the mixed fruit pomace biscuit was found minimum i.e., 6.6 when it was baked for less time and on high temperature. Spread ratio was found maximum 8.2 of those samples which were baked at 200 ºC for 20 min and was made by incorporating 15 % mixed fruit pomace powder in it. During shelf life study it was observed that moisture content of control and treatment did not show any increase or decrease from zero to 20 days but after 40 to 60 days there was a slight increase in the moisture content of control and experimental samples. Protein content in experimental samples was found maximum 9.56 and in control sample it was minimum 7.78, it was also calculated that after 20 days of storage protein content of biscuit was reduced.

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