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Process Development for the Value Addition of Banana Central Core (Pseudo Stem)

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Abstract: ***Banana centre core also known as Pseudostem, a biological waste in banana plantations could be effectively utilized as a source for incorporation in bakery food products preparations by converting them into flour. In this study, an attempt was made to develop a process for the value addition of banana central core, by drying and powdering. Cleaned and sliced banana centre core was dried in a cabinet dryer/Tray dryer different temperatures (50, 60 & 70°C) temperature. The dried samples were ground into powder form. The drying characteristics and the quality of the dried material and flour were analysed for the physicochemical properties. The sample dried at 70°C temperature was found to be better in terms of quality of the flour. This powder was used for the preparation of biscuits by incorporating at various levels. The quality of the biscuits were also analyzed.***

Keywords : Banana pseudo stem, tray drying, stem powder, biscuits

I. INTRODUCTION

Banana is an important fruit crop grown mainly in tropical and sub tropical areas. The stem (also termed as pseudostem) of the plant is considered as a waste and is mostly burnt in the field. It is composed of concentric layers of sheaths. The centre core of banana mainly comprises of about 90 per cent of water. It is mainly used as a plant fibre and is used for various purposes. In the earlier days, natural fibres served a crucial role to mitigate the everyday needs for a wide range of uses. But in recent years, the arrival of synthetic products is dominating over the natural fibre due to the low cost [1], [2]. But the synthetic fibres are non - degradable and causing serious pollution problems. The pseudo-stem has many medicinal properties. In many parts of the country, the centre core of banana crop is used as a vegetable for making different culinary products[3].

Dietary fibre is made up of carbohydrate polymers derived from plants consists of more monomeric units that are resistant to hydrolysis by the endogenous enzymes in the small intestine of humans with complete fermentation in the colon where it can promote beneficial micro fauna growth. Starch and polysaccharides (NSP) are the most important components of dietary fibre are the NSP include insoluble dietary fibre (cellulose, lignin and hemicelluloses) and soluble dietary fibre (mucilage and gums). Reduced intake of NSP in the daily diet has been associated with an increased incidence of certain food-related health problems, including obesity, cardiovascular disease, diabetes, colorectal cancer and various digestive disorders [4].

The epidemiological studies that are conducted indicate that the NSP content of fruits, vegetables and cereals are good sources of soluble and insoluble dietary fibre and this helps in maintaining the digestive system and human health through biological and physiological effects. The bioactive compounds of banana pseudo-stem extracts have been reported to enhance the uptake of glucose into cells, and is beneficial for the diabetes [5].

The processing of banana pseudo- stem into flour can provide a means for prolonging its shelf life and also prevent the spoilage[6],[7]. Partially substituting banana pseudo-stem flour for wheat flour in bakery products has the potential to increase dietary fibre intake [8]-[11]. The objective of the study is to use the dietary fibre from the pseudo-stem flour for incorporation in bakery products and replace the fibre content from other flours.

II. MATERIALS AND METHODS

A. Raw Material

The psedostem of Poovan variety of banana was procured from a local market in Coimbatore, Tamilnadu. The raw material was cleaned with tap water followed by the removal of outer sheaths and stored in refrigerated condition for further use.

B. Drying of Pseudostem and powdering

The inner core was sliced using slicer and soaked in for half an hour or in 0.2% w/w Potassium metabisulphite for 10 minutes for the purpose of controlling the browning reaction. The core pieces were then drained and subjected to drying in a laboratory tray dryer at 50, 60 and 70°C.

C. Physico chemical analysis of different properties of pseudo stem flour

1. Determination of Moisture Content

The moisture content of the sample was estimated by hot air oven method [12]. Dry the empty dish and lid in the oven at 105 ℃ for 3 h and transfer to desiccator to cool. Weigh the empty dish and lid. Weigh about 3 g of sample to the dish. Spread the sample to the uniformity.

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Place the dish with the sample in the oven. Dry for 3 h at 105℃ after drying transfer the dish with partially covered lid to the desiccator to cool. Reweigh the dish and its dried sample.

2. Estimation of pH

The pH is e measure of the active acidity which influences the flavor or palatability of a product and affects the processing requirements. The pH value was determined using a pH meter and was standardized with distilled water of pH 7.0.

3. Total Soluble Solids (TSS)

About 2g of sample was taken and stirred in 50 ml of water. The content was filtered and using a handheld refractometer, the TSS was determined. This is expressed as degree brix.

4. Total Titrable Acidity (TTA)

Approximately 2g of powder was extracted with 30 ml distilled water and 20 ml methanol at 45℃ for 15 minute in a water bath. The mixture was filtered and 4 ml of filtrate was pipetted into a flask containing 5 ml distilled water followed with the addition of 3 drops of 1% phenolphthalein. The mixture was then titrated against 0.1 N NaOH until the faint pink end point persisted for 30 seconds.

5. Determination of Ash content

The total ash content of the sample was determined as described in (AOAC, 2000). About 5 g of the sample was taken in crucible. The sample was kept in muffle furnace at 555℃ for 5 hours. The crucible was taken out and allowed to cool to room temperature in a desiccator. The final weight was taken and the percentage of ash content was determined using the following formula.

Ash content(%) = $[(W_1 – W_2) / W_1] \times 100$

Where,

W_1 = Initial weight of sample (g)

W_2 = Final weight of sample (g)

6. Estimation of Iron

The ash is moistened with a small amount of distilled water and add 5ml of hydrochloric acid to it. The mixture is evaporated to dryness in a boiling water bath. Another 5ml of hydrochloric acid was added again and the solution was evaporated to dryness as before.4ml of hydrochloric acid and a few ml water are then added and the solution was warmed over a boiling water bath and filtered into 100ml standard flask using Whatmann No:40 filter paper. After cooling the volume was made up to 100ml. To aliquots of working standard solution 1,2,3,4,5 ml corresponding to 10,20,30,40,50 of iron in a series of test tubes. Take 2ml of unknown solution in test tubes.1ml of potassium per sulphate and 1 ml of sulphuric acid are added to all the test tubes. Make up the solution in all the test tubes to 8.5ml with distilled water and the blank was prepared simultaneously by adding all the reagents except the standards. Add 1.5ml of 3 N potassium thiocyanate to all the test tubes for the development of colour. Allow the colour to develop for 20 minutes and then read the intensity of colour at 530 nm colorimeter.

7. Determination of Fibre Content

The fibre content of the sample was estimated by the method as described in [12]. Weighed 4g of defatted sample and added to 200 ml of 1.25% sulphuric acid held in 550 ml beaker and glass rod should be dipped in the beaker and boiled for 30 min in hot plate. Any loss in volume during boiling was made up with distilled water. The solution was filtered and the residue was collected and rinsed with distilled water. To the residue, 200 ml of 1.25% sodium hydroxide was added and boiled for 30 minutes. The liquor was filtered through a cotton cloth and the residue washed with distilled water until the washing was on alkaline. The residue was dried at 105℃ for 3 h and weighed again.

D. Incorporation in Biscuit

1. Preparation of biscuit

For the biscuit preparation all the basic ingredients were purchased from the market. Biscuit were prepared under basic ingredients Maida, sugar, butter. Later pseudostem powder dried at 70℃ was used for incorporation at different weight. Firstly maida was sieved along with powdered sugar. This flour was mixed thoroughly and butter and baking powder were added. This mixture was kneaded along with pseudostem powder and was made into dough and kept aside for leavening. The dough was rolled and cut into proper shapes. Finally it was baked at 120℃ for 15-20 minutes and allowed to cool.

2. Trials in Biscuits

Different composition of the extracted pseudo stem powder was added to the Biscuit flour (control, 3g, 5g and 8 g respectively per 50 g of all-purpose flour).

Table 1 Preparation of Biscuits- Trials

Raw materials	Control	T1	T2	T3
Flour (g)	50	47	45	42
Pseudostem powder (g)	0	3	5	8
Butter (g)	20	20	20	20
Sugar (g)	25	25	25	25
Salt (g)	0.5	0.5	0.5	0.5
Water (ml)	10-15	10-15	10-15	10-15
Baking Powder (g)	0.5	0.5	0.5	0.5

Fig.1 Flow chart for the preparation of Pseudostem powder

3. Chemical Analysis of Biscuits

a. Fibre Content Estimation

The fibre content of the sample was estimated by the method as described in AOAC, 2000.

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b. Protein content Estimation

The total protein in the sample was determined according to the Kjeldahl method as described in [12].

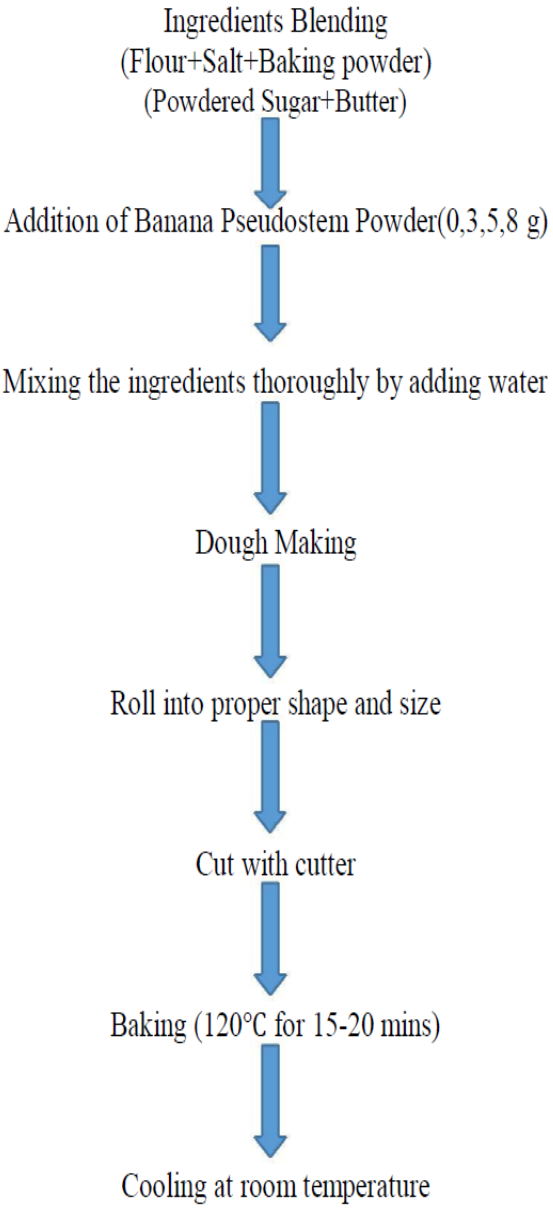

Fig. 2 Flowchart for preparation of biscuits

Fig.3 Sliced banana pseudo stem before drying

Fig. 4 Banana pseudostem powder

III. RESULTS AND DISCUSSION

A. Drying characteristics of sliced Pseudostem

Pseudostem after slicing and pretratment was subjected to drying in Tray dryer at different temperatures ranging from 50, 60 and 70℃.The weight of pseudostem was noted at a time interval of every 30mins until the weight became constant. The weight reduction of the samples is provided in the Table 2.

From the table 2, it can be observed that the weight of the samples decreased at a faster rate with the increase in temperature of the drying system. It took about 240 minutes to reach constant weight at the dryer temperature of 50℃ whereas at the temperature of 70℃ the constant weight was reached at 150 minutes [13].

Table 2 Drying of banana pseudostem in Tray dryer

Drying Time(mins)	Weight Reduction (g)		
	50℃	60℃	70℃
0	1660	1660	1.660
30	1560	1530	1.520
60	1480	1450	1.420
90	1420	1400	1.380
120	1400	1380	1.360
150	1380	1360	1.360
180	1380	1360	
210	1360		
240	1360		

B. Physio chemical analysis of pseudostem powder

About 80g of powder was obtained from 3kg of fresh psuedostem and the powder had a brownish tint color. The physio chemical properties of pseudostem powder was analysed for moisture content,pH, TSS(Total Soluble Solids),TTA(Total Titrable Acidity), fibre content, ash content, iron content were found out using various instruments and chemical methods[12], [14].The results are given in figures 5 to10.

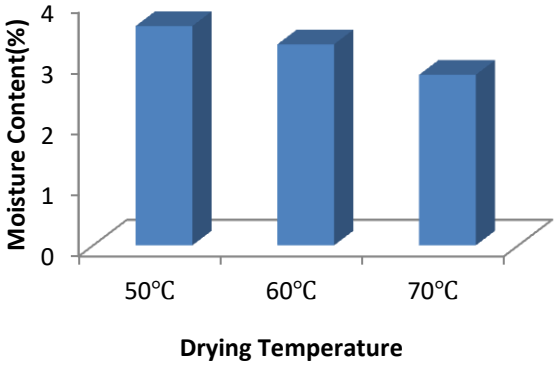

Fig. 5 Moisture Content of the Powder

The moisture content of the pseudostem slices was found to be less and dried at a shorter time for the samples when dried at 70°C because of the rapid removal of moisture at a faster rate (Fig. 5).

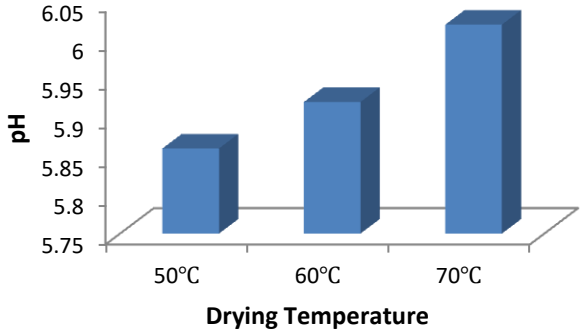

Fig. 6 pH of the Powder at different drying temperature conditions

The pH value was found to be slightly acidic with a range of 5.86 to 6.02 with the highest being in the 70°C with 6.02. The pH value of 50°C and 60°C was found to be 5.86 and 5.92 respectively (Fig. 6).

The TSS value was found to be between 1-1.2°brix with the highest being at 70°C and 1°brix at 50and 60°C respectively(Fig. 7).

The total titrable acidity was found to be around 0.04 to 0.05 with the highest at70°C (Fig.8).

The fiber content was found to be higher (15.2%) at 70°C when compared to other temperatures. The fiber content at 50°C and 60°C was found to be 14.3% and 15% respectively (Fig.9).

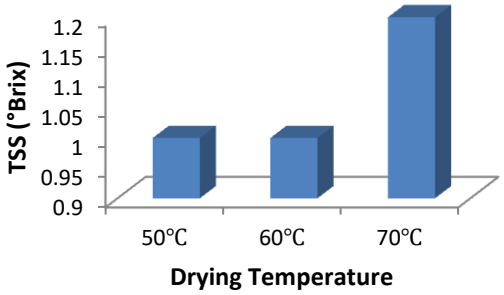

Fig. 7 TSS values of the Powder at different drying temperature conditions

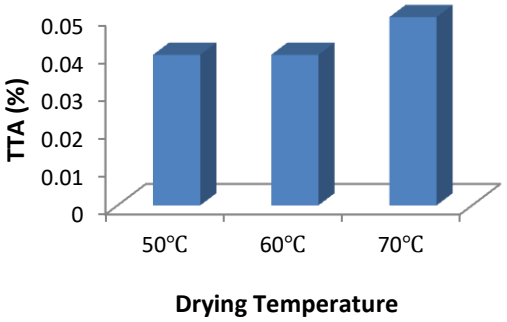

Fig. 8 TAA values of the Powder at different drying temperature conditions

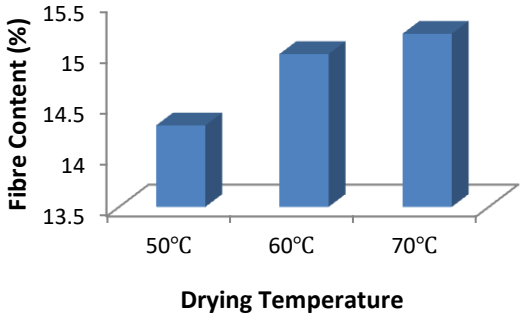

Fig. 9 Fibre content of the Powder at different drying temperature conditions

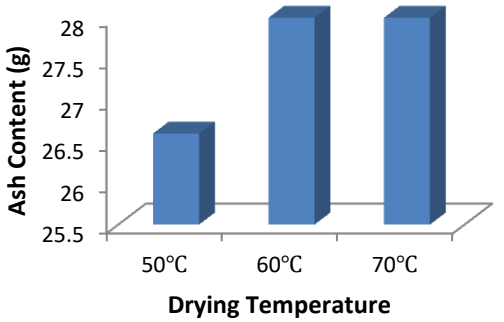

Fig. 10 Ash content of the Powder at different drying temperature conditions

Ash content of pseudostem powder at different temperature was found to be 26.6g for 50°C, 28g for 60°C and 70°C respectively.

This showed that the increase in drying temperature after a certain range did not affect the ash content of the psedostem (Fig.10).

The Iron content was estimated using absorbance at 530nm using spectrophotometer and was found to be higher in 70℃ with 13% and found to be least in 50℃ with 11% and 12% in 60℃ (Fig.10).

The physiochemical analysis showed that the quality retention of pseudostem dried at 70℃ was found to be higher compared to the pseudostem dried at temperatures of 50℃ and 60℃ since the tray drying at higher temperature yields more quality retention capacity.

Hence, the powder obtained at a temperature of 70℃ which showed good quality parameters was used for incorporation as a fibre substitute in the preparation of biscuits.

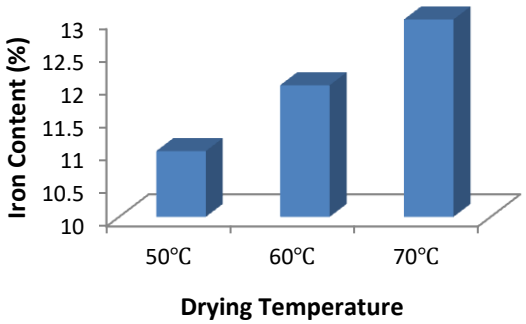

Fig. 11 Iron content of the Powder at different drying temperature conditions

C. Chemical Analysis of Biscuits

The fibre and protein content of the biscuits were found and the data is provided in Table 5. The fiber content of biscuits with pseudostem powder of 8g was found to be higher with 3.5%, which is followed by 5g with 3.1% and 3g with 2.8%. The fibre content in biscuits is essential since it is one of the important dietary requirements to tackle various diseases. Protein is an important nutrient which helps in building muscles The protein content was estimated to be higher in 8g pseudostem powder which was found to be 4.6% followed by 5g and 3g with 4.2% and 3.9% respectively [15].

Table 3 Chemical analysis of biscuits

Constituent	Pseudostem powder quantity			
	Control	3g	5g	8g
Fiber Content, %	1.6	2.8	3.1	3.5
Protein Content, %	2.8	3.9	4.2	4.6

IV. CONCLUSION

Experiments were conducted in order to incorporate the dried banana pseudostem powder in biscuits. The pseudostem was sliced and dried in tray dryer at various temperatures(50-70℃). From the results of the drying characteristics it was found that the powder obtained from the slices dried at 70℃ was good. The powder was analized for physic-chemical properties. This powder was incorporated as a substitute for fibre content in biscuits. The quality parameters of the biscuits were also studied. Through this study, the pseudostem of banana which is considered as a bio waste was effectively utilized by value addition in biscuits.

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