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Some Functional, Physico-Chemical and Sensory Properties of Arrowroot Flour and Chiffon Cake Products

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Abstract

Flours from three arrowroot (*Maranta arundinaceae* L.) accessions (PRM 2, PRM 19, PRM 23) were prepared and baked into chiffon cakes with wheat cake flour as the control in order to determine functional properties and sensory attributes of the resulting products. The three arrowroot flours were high in water absorption, viscosity, amylose and fiber contents while their fat absorption was almost similar to that of the wheat cake flour. The general acceptability scores of chiffon cakes from arrowroot flours (PRM 2, PRM 19) were 6.19 and 6.55, respectively, which fell between "like slightly" and "like moderately" in the Hedonic scale. Though significantly different, the acceptability ratings of chiffon cakes from arrowroot flours tended to be near the acceptability value of wheat cake flour. This means that arrowroot flour can be used as new material in cake making especially if color of the flour is improved.

Keywords: *Maranta arundinaceae* L., root crops, bakery products

Introduction

Bakery products are very popular. Their popularity comes from the wheat flour which is the main source for their production. But the fact remains that wheat flour is imported and expensive. And since it is supplied by a few countries, rising demand for wheat and bakery products will cause disastrous effects on the economy of developing countries like the Philippines. Therefore, utilization of root crops like arrowroot flour in bakery products will lessen our dependence on other nation's wheat. Arrowroot (*Maranta arundinaceae* L.) or "uraro" rhizomes are traditionally steamed, fried, baked, or eaten as boiled or roasted (Andam, 1985). It has received little attention and has limited food uses except in Laguna and Bataan where rhizomes are the source of fine grain starch used in making "uraro" biscuit. Arrowroot is usually used for its grain starch content. it is not processed into flour due to its high fiber content (Andam, 1985). This study aimed to determine and compare the functional and physico-chemical properties of arrowroot and wheat cake flour; and to compare the sensory qualities of chiffon cake baked from arrowroot and wheat cake flours.

Material and Methods

Sample collection and preparation. Fresh rhizomes of arrowroot were obtained from the Philippine Root Crop Research and Training Center (PRCRTC), Visayas State College of Agriculture (ViSCA), Baybay, Leyte. Three arrowroot accessions (PRM 2, PRM 19, AND PRM 23) were used. The rhizomes were washed with tap water to remove the adhering foreign materials and then thinly cut using a root crop slicer. The chips were collected in a basin of water to prevent discoloration, spread out on a tray and dried employing an electric food dryer. Dried chips were ground using an electric grinder and allowed to pass through a silkscreen (80 mesh) to separate the fine flour from the coarse one.

Determination of functional properties. Chemical composition and functional properties of flour from the three arrowroot accessions were evaluated. The amylose content was determined following the standard methods of Cagampang and Rodriguez (1980).

Fat absorption, water absorption, and viscosity were determined following the methods of Sosulski (1962), Lin et al., (1974), and Circle et al., (1964), respectively. Similar analyses were also made on wheat cake flour:

Preparation of chiffon cake. A 100% arrowroot flour was processed into chiffon cake following the procedure adopted by the Department of Agricultural Chemistry and Food Science (DAC-FS) of ViSCA. Chiffon cake from wheat flour was used as control.

Volume measurement. The specific volume of the cake was determined using seed displacement method by Claudio and de Leon (1977).

Sensory evaluation. Cake processed from arrowroot and wheat cake flour were sliced uniformly into small pieces prior to sensory evaluation. A glass of water was provided to every panelist for rinsing in between sampling. Cake slices were presented to 24 untrained panelists who were either staff or students of ViSCA. The panelists evaluated the sensory properties such as color, uniformity of airholes, size of airholes, sponginess, flavor, and general acceptability using the Hedonic scale of I to 9 where 1 dislike extremely, 5 == neither like nor dislike and like extremely.

Statistical analyses. The data on functional, physico-chemical and sensory properties were subjected to analyses of variance (ANOVA) following the Completely Randomized Design (CRD). Mean differences were compared using the Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1976).

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Results and Discussion

Water absorption. Percentage of water absorption by the wheat flour was lowest and was significantly different from the three arrowroot flours (Table 1). The high amount of water absorbed by the arrowroot flours could be due to its high dietary fiber content which ranged from 6.04 to 6.52%. Fiber in food is important in the prevention of colon cancer (Mullin and Smith, 1991) thus arrowroot flour stands a chance in the food industry.

Table 1. Functional and physico-chemical properties of arrowroot and cake flours

Flour Source	Water Absorption (%)	Fat Absorption (%)	Viscosity at 0.5% concn (cP)	Amylose Content (%)	Fiber Content (%)	Specific volume (ml/g)
Wheat	43.50b	47.40a	54.75b	16.12c	4.47b	3.90a
PRM 2	65.33a	48.32a	119.50a	24.98b	6.52a	3.20b
PRM 19	63.97a	49.89a	131.75a	28.42a	6.53a	2.91b
PRM 23	63.97a	46.37a	106.50a	24.45b	6.04a	3.24b

Means in a column with common letters are not significantly different at 5% level of significance using DMRT

Fat absorption. Fat absorption of arrowroot is the same as the fat absorption of wheat flour.

Viscosity. Viscosity of wheat flour was lower than the flours from arrowroot. This might be due to its low amylose content of only 16.12%. The three arrowroot accessions exhibited amylose contents ranging from 24.45 to 28.42% (Table 1). As observed earlier, a high amylose content in flours tends to exhibit a proportionally high viscosity (Sandhya Rani and Battacharya, 1985).

Specific volume. Chiffon cake from flour had higher specific volume at 3.90 ml/g while cake from the different arrowroot flours exhibited specific volumes ranging from 2.91 to 3.24 ml/g- Obviously, gas retention in the wheat flour cake was far better than in the arrowroot chiffon cake. This may be explained in terms of the unique cohesive-elastic properties of hydrated gluten, mainly glutenin fraction which is responsible for the excellent characteristics of wheat flour (Anglemeir and Montgomery, 1975). Although wheat cake flour contains lower protein, it is possible to have sufficient gliadin and glutenin to make the cake tender and thus a higher specific volume, Gluten has been reported to comprise of both gliadin and glutenin; the gliadin proteins according to Anglemeir and Montgomery (1975) govern the loaf volume potential of flour mixtures. Evidently, optimum expansion of gas in the mixture and retention of its structure are largely protein-dependent. It is inferred that with a refinement in the processing method, the specific volume of arrowroot flour may be improved.

Sensory quality of chiffon cake. Table 2 shows the mean sensory scores of

chiffon cakes using four different flours. Wheat cake flour had a color rating of 7.96 which was significantly different from the color of chiffon cakes from arrowroot flour. This was also true for the uniformity of airholes, size of airholes, sponginess, flavor, and general acceptability. Chiffon cakes from the arrowroot flours generally obtained lower scores. The low rating for color can be attributed to the light brown color of arrowroot flour as compared to the pearly white color of wheat flour. Bleaching is done in wheat cake flour aside from the added starch which makes cake flour whiter than other flour types.

Table 2. Mean [a] sensory scores [b] of chiffon cake using arrowroot and wheat cake flours

Flour Source	Color	Uniformity of Airholes	Size of Airhole	Sponginess	Flavor	General Acceptability
Wheat	7.96a	7.42a	7.25a	7.14a	7.51a	7.16a
PRM 2	6.02b	5.98b	5.92b	6.17b	6.46b	6.19bc
PRM 19	6.26b	6.11b	5.96b	6.40ab	6.65b	6.55b
PRM 23	5.19c	5.65b	5.54b	5.74b	5.80c	5.97c

[a] *Means in a column with common letter are not significantly different at 5% level of significance using DMRT*

[b] *1- Dislike extremely ; 2 - Dislike very much; 3 - Dislike moderately; 4 - Dislike slightly; 5 - Neither like nor dislike; 6 - Like slightly; 7 - Like moderately; 8 - Like very much; 9 - Like extremely*

Amerine et al, (1965) reported that food selection is conditioned by its color. Attractive cakes from wheat flour significantly obtained the highest general acceptability score but cakes from PRM 2 and PRM 19 had scores of 6.19 and 6.553 respectively, which fell between "like slightly" and "like moderately" in the Hedonic scale. Based on statistical analysis, these scores are different from wheat flour. This means that arrowroot flour may be a new material in cake-making especially if color of the flour is improved.

Conclusions and Recommendations

This study showed that the consumer acceptance of the chiffon cake from wheat cake flour was better than the cake from arrowroot flour. But cakes from arrowroot flour were still acceptable based on general acceptability ratings of 6.19 and 6.55, respectively, as shown by cakes baked from PRM 2 and PRM 19. These ratings fell between "like slightly" and "like moderately" in the Hedonic scale.

Arrowroot flours differed in functional properties compared with wheat cake flour but is not necessarily inferior in viscosity and fiber content as these were higher than wheat cake flour. Given similar preparation treatments such as bleaching, and adding of starch, arrowroot flour can be a potential high fiber cake flour source.

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