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Effect of Different Storage Condition on Nutritional Value of Puttu

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Abstract: *India has a wealth of indigenous intelligence in creating new and healthy food products. Among diverse food culture of India, the indigenous food products and processing techniques which belong to southern region of India puttu was selected for execution of study in this research project which has the wider scope of industrialization, expediency and therapeutic value. Popular rice (Oryza sativa L.) cultivars namely raw rice (IR20), parboiled rice, brown rice (kaikuthal arisi), red rice (matta rice) and black rice (kavuni rice) were selected for the development of puttu. All the puttu rice flour samples were introduced in different storage conditions like room temp. (±30^{0}C), refrigeration (±4^{0}C) and freezing (±17^{0}C). Puttu samples prepared were evaluated for physicochemical parameters. The energy content was high in raw rice puttu (317.33Kcal) followed by black rice puttu (309.21Kcal). Thus, lowest energy value was obtained in red rice puttu (201.67 Kcal). The processing techniques like refrigeration and freezing was found to reduce energy value of puttu among different varieties as there was significant difference in the values obtained.*

Keywords*: Puttu, Flour, Rice, food*

I. Introduction

Cereals are the most important sources of food (FAO 2002), and cereal based foods are a major source of energy, protein, B vitamins and minerals for the world population. Generally, cereals are cheap to produce, are easily stored and transported, and do not deteriorate readily if kept dry. Puttu is a breakfast in South India especially Kerala. It is a form of rice cake made in a special cylindrical vessel eaten usually with banana or legumes. Puttu pronounced is a South Indian and Kerala breakfast dish of steamed cylinders of ground rice layered with coconut. It is highly popular in the Indian state of Kerala as well as in many areas of coastal Kanara region of Karnataka, Sri Lanka, where it is also known as puttu. Puttu principally consists of coarsely ground rice, grated coconut and water. Among many varieties of rice, raw rice, matta rice (or red rice), IR20 rice is often used for producing Puttu. Physicochemical and metabolic properties of rice are influenced by numerous factors. One of these factors is amylose content, which is often used to predict starch digestion rate, blood glucose and insulin responses to rice.

II. Materials and Methods

Selection and preparation of rice flour for puttu

Puttu flour preparation: Five commercial cultivars of Rice (*Oryza sativa L.*) samples namely raw rice (IR20), parboiled rice, brown rice (kaikuthal arisi), red rice (matta rice) and black rice (kavuni rice) were purchased from local markets in Thanjavur. The samples were coded A-E, while **Fig.1** shows the photographs of the samples. The samples were cleaned and soaked in water for 1 hour at 30^{0}C. The soaked samples were drained and dried at 30^{0}C. The dried rice samples were ground using a hammer mill (Lab Model: A1, Madurai), and passed through 50-mesh sieve. The ground flour was roasted with an uruli roaster at 140^0 C for 3 minutes before they were stored in air-tight containers prior to analysis.

Fig 1. Types of Rice Used for Puttu*:* From left to right: **A)** Raw Rice, **B)** Parboiled Rice, **C)** Brown Rice, **D)** Red Rice and **E)** Black Rice

Preparation of puttu: Puttu was prepared by mixing flour with water and added salt, loosely packed in a household apparatus (i.e. a steamer in cylindrical or dome shape) followed by steam cooking (metal Puttu maker consist of two sections). Raw rice, parboiled rice, brown rice, red rice and black rice were used in the present study to determine the properties of starch. The various process treatments involved in development of Puttu are given in the **Fig 2.**

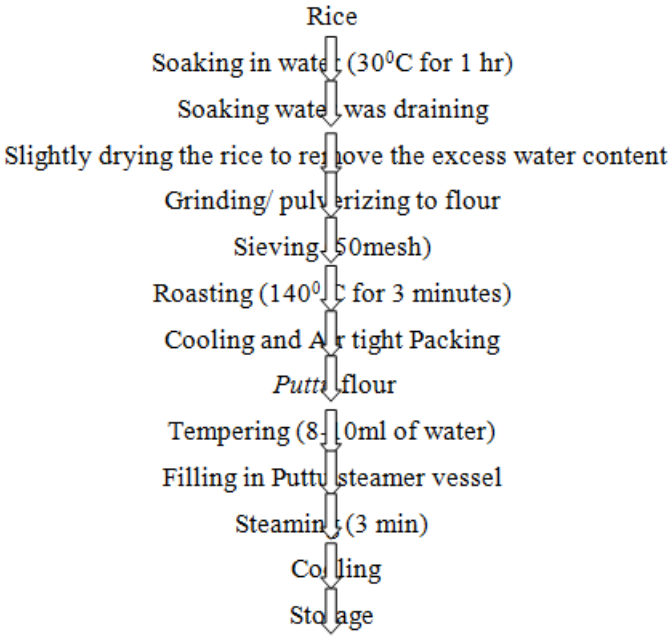

Fig. 2 Flow Sheet for Processing of Puttu

Details of the processing treatments

Raw rice, parboiled rice, brown rice, red rice and black rice based Puttu were prepared and determined the properties of starch. All the puttu rice flour samples were introduced in different storage conditions like room temperature (±30^{0}C), refrigeration (±4^{0}C) and freezing (±17^{0}C) involved in development Puttu. The puttu prepared with different variety of rice were subjected to different treatment. The treatments used for processing are given in Table.1.

Table 1. Treatments Involved in Development of *Puttu* from Various Types of Rice flour

Control (±30^{0}C)		**Refrigeration (±4^{0}C)**		**Freezing (±17^{0}C)**	
T_1	Raw rice *Puttu*	**T_1R_1**	Raw rice *Puttu* + Refrigeration + Steaming	**T_1F_1**	Raw rice *Puttu* + Freezing + Steaming
T_2	Parboiled rice *Puttu*	**T_2R_1**	Parboiled rice *Puttu* + Refrigeration + Steaming	**T_2F_1**	Parboiled rice *Puttu* + Freezing + Steaming
T_3	Brown rice *Puttu*	**T_3R_1**	Brown rice *Puttu* + Refrigeration + Steaming	**T_3F_1**	Brown rice *Puttu* + Freezing + Steaming
T_4	Red rice *Puttu*	**T_4R_1**	Red rice *Puttu* + Refrigeration + Steaming	**T_4F_1**	Red rice *Puttu* + Freezing + Steaming
T_5	Black rice *Puttu*	**T_5R_1**	Black rice *Puttu*+ Refrigeration + Steaming	**T_5F_1**	Black rice *Puttu*+ Freezing + Steaming

Puttu prepared by the process given above with different varieties of rice is control T_1 to T_5. The puttu prepared as per the fig.1 was refrigerated at (±4^{0}C) with treatments from T_1R_1 to T_5R_1. Puttu was also Freezed (±17^{0}C) with different varieties of rice puttu (T_1F_1 to T_5F_1).

Chemical Analysis

Puttu has been developed and its nutrient composition was done. Puttu prepared with different treatments was estimated for the proximate composition. The moisture, fat, crude proteins (% N x 6.25) of the samples were determined by the AOAC method (2000) on triplicate samples of the cookies. Crude protein was determined based on AOAC Method 960.52: Micro-Kjeldahl Method (AOAC, 2000). Fat was conducted based on AOAC Method 963.15: Soxhlet Extraction Method utilizing petroleum ether as solvent (AOAC, 2000). Carbohydrate content was estimated by difference and caloric value was measured by calculation. Energy was calculated by the Atwater method (Protein x 4; Fat x 9; Carbohydrate x 4).

III. Results & Discussion

CHEMICAL ANALYSIS

The carbohydrates value of the five rice varieties puttu was determined the raw rice puttu had 69.51g and lowest was found in 40.15g/100 g which shows that the grains of these varieties are rich source of energy. The suitability of the rice puttu was evaluated based on the energy value and processing in selected five popular varieties of rice and the results of control puttu, refrigerated puttu and freezed puttu are tabulated and given in the Table 2. The red rice puttu showed significant decrease with the storage condition.

Table 2. Carbohydrates content of puttu with different storage condition

Treatment	Carbohydrate					P value
	T1	T2	T3	T4	T5	
Control	$69.51\pm3.02^{a,A}$	$52.06\pm3.53^{c,A}$	$42.75\pm3.04^{d,A}$	$40.15\pm1.48^{d,A}$	$59.62\pm1.14^{b,A}$	0.000
Refrigerated	$62.95\pm3.11^{a,C}$	$46.97\pm1.65^{c,AB}$	$37.56\pm1.23^{d,B}$	$34.73\pm1.88^{d,B}$	$57.59\pm1.17^{b,AB}$	0.000
Freezed	$64.25\pm1.88^{a,AB}$	$45.68\pm3.52^{c,B}$	$36.54\pm1.51^{d,B}$	$31.25\pm0.97^{e,C}$	$56.5\pm0.76^{b,B}$	0.000
P value	0.056	0.90	0.023	0.01	0.028	

Values are the mean ± standard deviation. All the samples were taken in triplicates.

Protein content of puttu prepared from raw rice flour was found to be 6.52%. Highest protein content was found to be present in black rice puttu (15.17%) followed by Brown rice puttu (12.44%). Protein content was found high in control samples of puttu and there was significant difference in the puttu stored at different temperature in control, but there was no significant difference between the refrigerated and freezed puttu. The protein values are tabulated in the Table 3. The loss on polishing are 29% of the protein, 79 % of the fat (Abbas, *et al.* 2011). Milling, decortication, fermentation and germination will increase protein digestibility (due to the removal of fibre and enzymic breakdown of proteins) but milling and decortication reduce the level of lysine, the limiting amino acid in cereals (Macrae et al. 1993).

Table 3. Protein content of puttu with different storage condition

Protein						
Treatment	T1	T2	T3	T4	T5	P value
Control	$6.52\pm0.36^{d,A}$	$5.56\pm0.06^{d,A}$	$12.44\pm1.33^{b,A}$	$7.91\pm0.30^{c,A}$	$15.17\pm0.39^{a,A}$	0.000
Refrigerated	$6.05\pm0.08^{d,B}$	$4.28\pm0.28^{e,B}$	$10.62\pm0.56^{b,B}$	$7.43\pm0.14^{c,B}$	$12.69\pm1.27^{a,B}$	0.000
Freezed	$5.39\pm0.15^{d,C}$	$4.23\pm0.18^{e,B}$	$10.8\pm0.22^{b,AB}$	$7.23\pm0.20^{c,B}$	$12.92\pm0.29^{a,B}$	0.000
P value	0.003	0.000	0.072	0.028	0.016	

Values are the mean ± standard deviation. All the samples were taken in triplicates.

Highest fat content was found in puttu prepared from brown rice puttu (3.04%) and the least was observed in red rice puttu (1.04%). There was no significant difference in the storage condition of red and black rice puttu, whereas, raw and parboiled rice had significant difference with the refrigerated and freezed puttu. The Fat content values are tabulated in the Table 4. Some of the grain's lipids, which are mainly present in the germ and bran, are distributed during milling into other fractions (Southgate 1993).

Table 4. Fat content of puttu with different storage condition

Fat						
Treatment	T1	T2	T3	T4	T5	P value
Control	$1.46\pm0.24^{bc,A}$	$1.71\pm0.18^{b,A}$	$3.04\pm0.19^{a,A}$	$1.04\pm0.23^{c,A}$	$1.11\pm0.38^{c,A}$	0.000
Refrigerated	$1.23\pm0.09^{c,A}$	$1.49\pm0.06^{b,A}$	$2.3\pm0.18^{a,B}$	$1.05\pm0.05^{d,A}$	$0.93\pm0.04^{d,A}$	0.000
Freezed	$0.88\pm0.08^{c,B}$	$1.11\pm0.08^{b,B}$	$2.18\pm0.04^{a,B}$	$1.05\pm0.08^{b,A}$	$0.78\pm0.04^{c,A}$	0.000
P value	0.011	0.002	0.001	0.999	0.268	

Values are the mean ± standard deviation. All the samples were taken in triplicates.

The energy content was high in raw rice puttu (317.33Kcal) followed by black rice puttu (309.21Kcal). Thus, lowest energy value was obtained in red rice puttu (201.67 Kcal). The processing techniques like refrigeration and freezing was found to reduce energy value of puttu among different varieties as there was significant difference in the values obtained. The energy values of the puttu obtained in trhe present study is tabulated in the Table 5. Variation in the energy values might be due to the hardness or staling during the processing techniques or temperature kept and also the extent of storage in particular temperature. During milling decrease in nutrients take place (Lloyd *et al*, 2010)

Table 3. Comparison of energy values of puttu prepared from different rice flour and processing techniques

Energy						
Treatment	**T1**	**T2**	**T3**	**T4**	**T5**	
Control	$317.33\pm15.65^{a,A}$	$254.97\pm27.37^{b,A}$	$248.15\pm5.10^{b,A}$	$201.67\pm3.33^{c,A}$	$309.21\pm1.39^{a,A}$	0.000
Refrigerated	$287.17\pm13.09^{a,B}$	$218.41\pm5.19^{b,B}$	$213.5\pm6.37^{b,B}$	$178.14\pm6.74^{c,B}$	$289.53\pm9.11^{a,B}$	0.000
Freezed	$286.49\pm8.29^{a,B}$	$209.67\pm13.30^{b,B}$	$209.04\pm4.77^{b,B}$	$163.38\pm3.97^{c,C}$	$285.04\pm3.50^{a,B}$	0.000
	0.040	0.045	0.000	0.000	0.004	

Values are the mean ± standard deviation. All the samples were taken in triplicates.

Generally there are variations in the nutrient content among different varieties but in the present study the higher protein content in black rice and low fat content in the red rice varieties of puttu prepared was found.

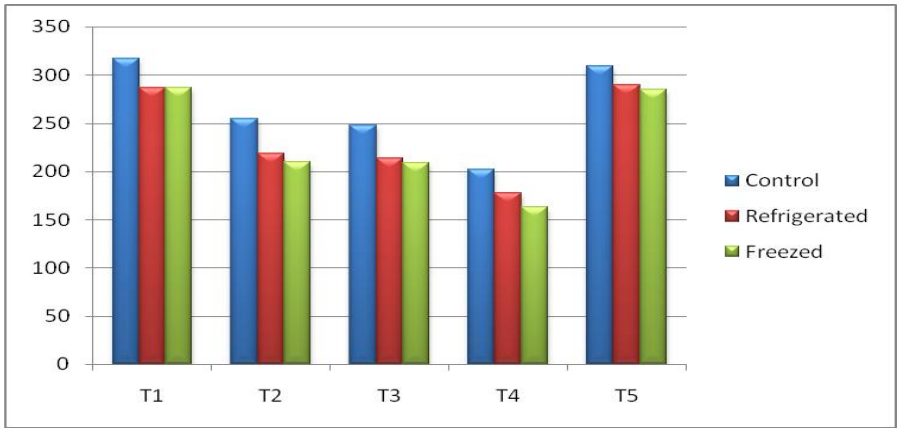

Fig.3 Energy values of different varieties of puttu processed in different storage conditions

During processing there is considerable reduction in the nutrients present in the rice flour puttu in all the varieties. This reduction is due to the reason that the amount of nutrients of rice vary according to factors such as climate, soil condition, variety, pH and others (Penna et al. 2001). The variability observed in carbohydrates, proteins, fat content is has influence in both genetic and environmental factors which may be the influence in chemical composition of the kernels of maize. The decreases and increase in the values obtained for the varieties of rice may be attributed to any environmental factors. The difference in the energy level is due to differences in the proximate composition of the varieties. The results of the present study show that these rice varieties are rich source of energy. Ikram Ullah (2010), reported the variability observed in carbohydrates, protein, fats, ash content, crude fiber and moisture content is both genetic and environmental which may influence the individual chemical composition and weight distribution of the endosperm and hull of the kernels. During processing there was considerable decrease in the energy values of the puttu. So this may also contribute to the difference in the nutrient content obtained in the present study.

IV. Conclusion

Energy value of puttu was higher in the rice varieties than the puttu stoed at different temperature. Black rice puttu prepared was found to be superior to other puttu and more accepted for its flavor, aroma and taste in both refrigerated and freezed puttu. Energy values of the puttu prepared with different rice and storage conditions had significance difference in the energy value. The storage condition decreases the energy value of the puttu. The low energy puttu can be developed for peoples who want puttu with low energy.

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