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Physico-Chemical Properties of Palmyrah fruit Pulp (*Borassus flabellifer* L)

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Abstract

Palmyrah fruit pulp is rich in nutritional values there is high scope for squash and jam preparation. The estimated trees in India are about 122 millions in which Andhra Pradesh itself having 50 millions. A number value added products from palmyrah available in market, but the fruit pulp is not commonly used for preservation and development of products due to lack of basic information of physico-chemical properties. Hence the study was taken up to analyse the pulp for physicochemical properties for development of health foods. Form this study it was observed that the fresh pulp powder contains, the moisture content was 74.5%. The ash and fat contents (wet matter basis) were 1.2% and 0.8% respectively. The protein content and carbohydrate content were 1.25% and 22.5% respectively. The caloric value obtained was 102.83 kcal/100 g. The pH value was 5.5. Water absorption capacity (18%) and bulk density (0.78 g/cm^3) were recorded for the palmyrah pulp powder. The values for swelling power and foam capacity were 4% and 2.5% respectively. The values gives significant values which can utilized direct or combined with other pulps for preparation of foods.

Keywords: Palmyrah Palm; Fruit pulp; Physic chemical properties

Introduction

The palmyra palm tree is a dioecious plant India stands first in the world in terms of its wealth of palmyrah (*Borassus flabellifer L*) palms with a population nearly 122 million palms [1].

The palm is found growing in Andhra Pradesh, Tamil Nadu, Bihar and Orissa and more number of palms is found in southern states of India. Palmyrah palm has great economic potential and every part of the palm is use full in one way or the other more than 88% of the Palmyrah is used for the welfare of the people, it serves as food (fruit, sap, young shoots) as a building material (the stem, the leaves) It is also used in the pharmacopoeia (roots, male inflorescence) and the leaves are used to make a variety of objects, brooms, baskets, fences and roofs [2] palm wine extracted form palmyrah plays an importation role in the diet.

Fruits mature during august and the ripe fruits fall from the palm during September and October. Each female palm may bear 10-20 bunches of about 200-300 fruits per year. When the fruit is very young, and the top of the fruit is cut off, you find usually three sockets inside and these contain he kernel which is soft as jelly, and translucent like ice, and is accompanied by a watery sweetish liquid. The mature fruit is usually tossed over low burning fire or embers to cook them mildly and the skin is peeled off to expose the juicy fruit. This is squeezed and the pulp removed. The pulp in itself is sweet and creamy and is delicious to eat. The pulp is usually sucked directly from the fibres of the fruit. The fresh pulp is reportedly rich in vitamins A and C. Palmyrah fruit pulp could be commercially utilized to produce food items and animal feed. The whole fruit contains about 40% of undiluted pulp which is dark yellow in colour with its characteristic flavor and bitterness. The pulp is extracted manually with water. Palmyrah pulp is mixed with other fruits for making jam, cordial, cream etc. since its pulp is bitter in taste, it is better to prepare mixed fruit jam rather than palmyah jam separately. To prepare cordials, citric acid is added to its diluted pulp and boiled. Well boiled cordial is bottled in white or amber colured bottles after adding approved food preservative [2]. Although utilization palmyrah fruit pulp is extensive, the literature on physic chemical properties is very limited. Hence this study was carried out to know the basic information of fruit and fruit pulp for developing value added products.

Material and Methods

The fruits (100 numbers) were collected randomly and taken weights for basic data to know the potential of pulp form palmyrah. The ripen palmyrah fruit pulp was collected and stored at cold room temperature (4°C) some of the pulp was direct at 6°C for 24-48 hrs. The dried pulp was finally milled using pulveriser to pass through a 250 um seave. The samples were then packaged in polyethylene bag (150) and kept in a refrigerator (4°C) until needed for use.

Functional properties

Color: The Color of the fresh pulp is observed visually and % transmission [3].

Solubility: The solubility tests were conducted with water, alcohol and acids.

pH: The pH of the fresh pulp was measured with digital pH meter using standard procedure [3].

TSS (total soluble solids): The T.S.S. of the fresh pulp is measured with hand refractrometer [3].

Water absorption capacity: This was determined using methods described by Beuchat [4] one gram sample was weighed into 25 ml graduated conical centrifuge tubes and about 10 ml of water added.

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The suspensions were allowed to stand at room temperature (30+2°C) for 1 hr. The suspension was centrifuge at 200xg (2000 rpm) for 30 min. The volume of water on the sediment was measured and the water absorbed is expressed as percent water absorption based on the original sample weight.

Bulk density: This was determined by the method of Narayana and Narasinga Rao [5] a graduated cylinder tubes were weighed and pulp powder sample filled to 5 ml by constant tapping until there was no further change in volume. The contents were weighed and the difference in weight determined. The bulk density was computed as grams per milliliter of the sample

Swelling power: This was determined with the method described by Leach et al. [6] with modification for small samples one gram of the sample was mixed with 10 ml distilled water in a centrifuge tube and heated at 80°C for 30 min. The mixture was continually shaken the heating period. After heating, the suspension was centrifuged at 1000 x g for 15 min. The supernatant was decanted and the weight of the paste taken. The swelling power was calculated as swelling power=weight of the paste/weight of dry sample.

Foam capacity and foam stability: The method described by Narayana and Narasinga Rao [5] was used for the determination of foam capacity (FC) and foam stability (FS) Two grams of pulp sample was added to 50 ml distilled water at 30+ 2°C in a 100 ml measuring cylinder. The suspension was mixed and properly shaken to foam and the volume of the foam after 30s was recorded. The FC was expressed as a percentage increase in volume. The foam volume was recorded in 1 hr after whipping to determine the FS as a percentage of the initial foam volume.

Physico-chemical properties

Moisture: The study was done by AOAC methods, about 10 g of the material is weighed (M1) into porcelain crucible and placed in an oven at 100-105°C and collected in a desiccators. The process of heating and cooling is repeated till a constant weight is achieved (M2) the moisture percentage is given by

Moisture (% wet basis)=(M1-M2)/M1 X 100

Protein by lowry method: This method was determined by Lowry et al., the lowry folin-ciocalteu (FC) reagents enables the determination of phenolic groups of tyrosine the fresh pulp sample was extracted with buffer and pipette out 0.1 to 0.2 ml of sample extract and make up to 1 ml with water. Add 5 ml of Alkalin copper and incubate for 10 min then add 0.5 ml of FC regent and incubate for 30 min read the O.D at 660 nm. The working standard proteins were prepared with 200 µg/ml. Draw the standard curve.

Lipid extraction: Lipids were extracted according to the method using soxhlet apparatus [3]. A mass M of each dry sample was weighed and introduced in to a previously weighed wattman cartridge. A cotton swab is then placed on top of the cartridge to prevent the rise during heating soxhlet apparatus and extracted with anhydrous ether for about 16 hr. The ether extract is filtered in to a weighed conical flask (M1) after an extraction time the solvent was evaporated on a rotary evaporator. The flask is dried in a desiccators for 2 hours and then weighed with the fat (M2)

The fact content is given by the equation

$$T=\frac{(M2-M1)\times 100}{M1}$$

Ash: The ash content was determined by AOAC method. About 5 g of pulp powder was calcified in a muffle furnace at 450°C during for 3-6 hr. The residue was weigh and converted to a percentage of ash.

Carbohydrate: the carbohydrate content was calculated by difference method.

I.e=100 - (m.c%+fat%+ protein%+ash%)

Identification of carbohydrates: The qualitative tests were performed to identify the carbohydrates i.e Molish test, Fehcing's test, Bendicts test, Seliwanofii's test, Barfoed's test, Bia's test, Inversion test and osazone test, for identifying the Amino Acids i.e Ninhydrin test, Xanthoprotic test, Millons test, Hopkins cole test, Paulys test, Selivons test, Ehrlichs test, Nitrotrusside tests were performed.

Total sugars: Fresh pulp of 100 mg was hydrolyzeed by keeping it in a boiling water bath for 3 hr with 5 ml of 2.5 n HCL of cool to room temperature. Then neutralized it with solid sodium carbonate and make up the vol to 100 ml of centrifuge. Then collect the supernatant and take 0.5 ml of 1 ml of aliquots for analysis. Prepare the standards by taking '0' as blank and 0.2 to 1 ml of working standard glucose (0.1 mg/ml) make up the volume to 1 ml by adding water. Then add 4 ml of anthrone reagent heat for 8 min in a boiling water bath. Cool rapidly and read the green to dark green colour at 630 mm. Draw the standard graph for standards [7-9].

Reducing sugars using 3,5 DNS method: 100 mg of fresh pulp sample was extracted with 80% alchohol pipette out 0.5 to 3 ml of sample of make upto 3 ml with H_2O. They add 3 ml of DNS and heat for 5 min. The add 1 ml of 40% Rochelle salt solution and cool the tubes and take OD at 540 mm using spectro photometer. The standard curve obtained with 1 mg/ml of glucose is used to determine the concentration of reducing sugars sample [7].

Starch by anthrone method : The fresh pulp sample was extracted with 80% hot ethanol add 5.0 ml of H_2O and 6.5 ml 52% perchloric acid kept at 0°C for 20 min and centrifuge save the supernatant repeat the extraction using fresh perchloric acid. Pipette out 0.1 or 0.2 ml of supernatant and make upto 1 ml with water. The standard glucose sample are prepared with the concentration of 0.1 mg/ml Then add 4 ml of anthrone and heat for 8 min. cool the tubes and take O.D at 630 mm [7].

Non reducing sugars: By subtracting the reducing sugars from the total sugars given the value of Non reducing sugars.

Maltose by 3,5 DNS method: The fresh pulp sample was extracted with 80% warm ethanol and centrifuge collect the supernatant and make up to 2 ml with water. Then add 2 ml of DNS reagent and cover with marble keep in boiling water bath for 10 min. cool and dilate to 10 ml with water and measure the OD at 520 nm. Calculate using standard graph maltose concentration is 1 mg/ml range from 0.1 to 2

Vitamin-C: The pulp sample is extracted with 4% oxalic acid. Then centrifuge pipette out 5 ml of supernatant and 10 ml of 4% oxalic acid and titrate against with the dye i.e. 2,6 dichlorophenol indophenols, observe the pink colour. The working standard prepared with ascorbic acid and titrates against with the dye.

Calcium: Pipette 20 to 100 ml of ash solution into 250 ml beaker add 25 to 50 ml of H_2O if necessary add 10 ml of saturated ammonium oxalate and 2 drops of methyl red indicator. Add dil ammonia and a few drops of acetic acid until the colour is fainst pink. Heat the solution to the boiling point. Allow to stand for overnight or 4 hr at room temperature. Filter through what man No -42 paper wash with

water, till the filtrate is oxalate free. Break the point of the filter paper with platinum wire or pointed glass rod. Washed the precipitate first using hot diluted H_2SO_4 from wash bottle into the beaker in which the calcium was precipitated. Then wash with hot water and titrate while still hot (Temp 70-80°C) with 0.01 u $KMNO_4$ to the first permanent pink colour.

Energy: This determination was made according to the method of Atwater which gives the following heat flow coefficients.

1 g of Carbohydrate Provides - 4 kcal

1 g of fat provides - 9 kcal

1 g of protein provides - 4 kcal

Results and Discussion

Functional properties

The colour of the pulp is light orange colour and gives orange colour wavelength in spectrophotometer. The solubility of the pulp is partially soluble in water, alcohol and acid solutions completely soluble in ether and chloroform. The pH of palmyrah fruit pulp powder is slightly acidic i.e pH range Between 5 to 6 as shown in Table 1. The T.S.S. of the fresh pulp is 16-16.5 Brix, with these desirable characteristics; the pulp can be used for food additive to enrich nutritional values [8].

Water absorption capacity

The water absorption capacity for the Palmyrah pulp powder was 18% (2.5 ml/g) (Table 1). Water absorption capacity describes pulp-water association ability under limited water supply. The result obtained shows that the pulp has a good ability to bind water. This result suggests that Palmyrah pulp powder could be used in bakery industry.

Bulk density

Bulk density is depended upon the particle size of the samples. The value obtained from the study was 0.78 g/cm^3 (Table 1). Bulk density is a measure of heaviness of a pulp sample. It is important for determining packaging requirements, material handling and application in wet processing in the food industry. Since pulps with high bulk densities are used as thickeners in food products, the Palmyrah pulp pulp could be used as a thickener [9].

Swelling power

The result for swelling power is presented in Table 1. The Palmyrah pulp powder has swelling power value of 4. Swelling power is a measure of hydration capacity, because the determination is a weight measure of swollen starch granules and their occluded water. Food eating quality is often connected with retention of water in the swollen starch granules.

Foam capacity (FC)

The foam capacity of the Palmyrah pulp pulp is shown in Table 1. The per cent foam capacity is about 2.5% which is lower in general. Foamability is reported to be related to the amount of solubilized protein [5].

Physico-chemical composition of pulp from palmyrah

The riped fruits data showed that 74% of them were large 3 seeded fruits with weight ranging from 450 g to 2200 g and a mean weight of 950 g of the remaining 18% were two seeded fruits and 8% were single seeded fruits were around 300 g in weight. In this study the average weight of palmyrah a seed was found to be 214 g and the average pulp weight per fruit was about 350 g ripe fruits and their seeds are used on a fairly large and profitable scale.

Moisture

Moisture provides a measure of the water content of the pulp and for that matter its total solid content. It is also an index of storage stability of the pulp. The moisture content of the fresh pulp was 74.77% (Table 1). The lower the moisture content, the better its shelf stability and hence pulp should be dried for storage.

Crude fat

The fat content of the Palmyrah fresh pulp was 0.8% (Table 2). This value is relatively high when compared to other pulps and similar to that reported by Sankaralingam et al. [2].

Crude ash

The per cent ash content of the pulp was 1.20% (Table 1). The ash content is the organic residue remaining after the organic matter has been burnt away. It is not necessarily of exactly the same composition as the mineral matter present in the original pulp as there may be losses due to volatilization or some interactions between constituents.

Crude protein

The per cent crude protein of the pulp was 1.236% (Table 2). The value obtained was however lower than that obtained by Sankaralingam et al. [2]. The difference observed may be contributed by varietal differences, maturation of the seeds and environmental conditions.

Carbohydrate

The major component of the pulp was carbohydrate. The value obtained from the study was 22.5% on fresh pulp and it shows higher carbohydrate content (Table 2).

Parameter	Values
Colour	Light orange
Solubility	Completely soluble in ether and chloroform
PH	5.5 to 6
T.S.S	16.5 Brix
Water absorption capacity (%)	3
Fat absorption capacity (%)	2.8
Bulk density (g/cm3)	0.78
Swelling Power (g/g)	4
Foam capacity (%)	2.5

Table 1: Functional properties of pulp from Palmyrah.

Parameter	Values for 100 g
Moisture	74-77%
Ash	1.2 g
Fat	0.8 g
Total Carbohydrates	22.5 g
Reducing sugar	9.5 g
Non Reducing Sugar	13 g
Starch	12.6 g
Maltose	0.5 g
Protein	1.24 g
Ascorbic acid	16 mg
Calcium	8.76 mg
Energy	102.83 k.cal

Table 2: Physico –chemical composition of pulp from palmyrah.

Energy

The caloric value (energy) of the Palmyrah pulp was 102.8 kcal/100 g (Table 2) on fresh weight basis. Also fresh pulp of 100 g having significant amount of sugars and minerals i.e Reducing sugar is 9.5 g, non-reducing sugar is 13 g, starch is 12.6 g, Maltose is 0.5 g, Ascorbic acid is 16 mg and calcium is 8.76 mg.

Conclusion

Form this study it was observed that the fresh pulp powder contains, the moisture content was 74.5%. The ash and fat contents (wet matter basis) were 1.2% and 0.8% respectively. The protein content and carbohydrate content were 1.25% and 22.5% respectively. The caloric value obtained was 102.83 kcal/100 g. The pH value was 5.5. Water absorption capacity (18%) and bulk density (0.78 g/cm^3) were recorded for the palmyrah pulp powder. The values for swelling power and foam capacity were 4% and 2.5% respectively. The values gives significant values which can utilized direct or combined with other pulps for preparation of foods and has a lot of potential in the food industry, especially its uses as nutritional enrichment in food and food based products. This information may be useful for further studies on anti-microbial and antioxidant activities.

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