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Physico-Chemical and Functional Characteristics of Palmyrah (*Borassus flabellifer L*) Spongy Haustorium flour

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Abstract

Palmyrah spongy haustorium is delicious and nutritive product from palmyrah seed nut at sprouting stage. It is also known as spongy endosperm and Thavan. The aim of this study is to determine the physico-chemical and functional properties of Palmyra spongy endosperm for its utilisation. The spongy endosperm collected and dried at 60 °C for 24 hrs, milled using pulveriser to pass through a 250 µm sieve, packaged in polyethylene bag and kept in a refrigerator (4 °C). The moisture content of the palmyrah spongy endosperm flour was 5.5 %. The ash and fat contents (dry matter basis) were 5.0 % and 2.1 % respectively. The protein content and carbohydrate content were 5.4 %, and 70.0 % respectively. The pH value is 7.0. Water absorption capacity (2.8%), fat absorption capacity (1.0 %) and bulk density (56 g/cm3) were recorded for the palmyrah spongy haustorium flour. The values for swelling power, foam capacity and foam stability were 345%, 5 % and 20 min respectively. The values moderately higher than of similar flours and the flour may be used direct or combined with other flours for preparation of foods.

Introduction

India stands first in the world in terms of its wealth of Palmyrah (*Borassus flabellifer* L) palms with a population nearly 122 million palms. The palm is found growing in Andhra Pradesh, Tamil Nadu, Bihar and Orissa states and more number of palms is found in southern states. Palmyrah palm has great economic potential and every part of the palm is useful in one way or the other. Spongy haustorium or Thavan formed during germination of seed nut is spongy, sweet and is a delicacy.

Methodology

Palmyrah spongy endosperm was collected from palmyrah nuts of just sprouted by opening of the nut using sharp tool or knife and stored at cold room temperature (4 °C). The spongy endosperm dried at 60 °C for 24 hrs. The dried one finally milled using pulveriser to pass through a 240 µm sieve. The samples were then packaged in polyethylene bag and kept in a refrigerator (~ 4 °C) until needed for use.

Physico chemical properties

The moisture content of the Palmyrah spongy endosperm flour was determined by AOAC (1999). The Total soluble solids (TSS) of the Palmyrah spongy endosperm was determined with hand refractrometer (Ranganna, 1986). The pH was determined with digital pH meter (Ranganna, 1986). Ash content was determined by heating sample at 600 ◌C for 3-4 hrs. The protein estimation was made by Lowery etal (1951). Lipids were extracted according to the method using Soxhlet apparatus (Ranganna, 1986). Total sugars determined by Thimmaiah (1999). Calcium, Iron and Phosphorus of the Palmyrah spongy endosperm was determined by using AOAC (1999). The energy (Caloric value) estimation was done by summing the multiplied values for crude protein, fat and carbohydrate (excluding crude fibre) by their respective factors (4, 9 and 4).

Functional properties

The functional properties of Palmyrah spongy endosperm powder were determined by using standard methods of analysis. Water and oil absorption capacity was determined by the method of Beuchat (1977). Narayana and Narasinga Rao (1984) method was used for the determination of bulk density. Swelling power was determined with the method of Leach etal (1959). Foam capacity (FC) and Foam stability (FS) was determined by Narayana and Narasinga Rao (1982).

Qualitative Phytochemical Screening

Palmyrah spongy endosperm powder was defatted with petroleum ether (60-80 ◌C) in a soxhlet apparatus. The defatted sample was further extracted with ethanol (95%).

Test for Flavonoids

To 1 ml of the extract, a few drops of dilute sodium hydroxide were added. An intense yellow colour was produced, which becomes colourless on addition of a few drops of dilute acid indicates the presence of flavonoids.

Test for Saponins

The Palmyrah spongy endosperm powder was diluted with 20ml of distilled water and it was agitated in a graduated cylinder for 15minutes. The formation of 1cm later of foam showed the presence of saponins.

Test for Phenolic Compounds

To the extract few drops of 1% lead acetate were added, the formation of a white precipitate indicates the presence of phenolic compounds.

Test for Glycosides

To the 1 ml of extract add glacial acetic acid, a few drops of ferric chloride and concentrated sulphuric acid is added and observed for the reddish brown colouration at the junction of two layers and the bluish green colour in the upper layer.

1.1. Test for Tannins

To 0.5ml of extract solution, 1ml of water and 1-2 drops of ferric chloride solution were added. Blue colour was observed for gallic tannins and green black for catecholic tannins.

1.2. Test for Alkaloids

To the extract solution Mayer's reagent (potassium mercuric iodide) was added. Formation of a yellow colour precipitate indicates the presence of alkaloids.

Results and Discussion

Physicochemical Properties

The Moisture content of the Palmyrah spongy endosperm powder is 5.5%. The moisture content of the food material is important to consider the food is suitable for the consumption. Moisture provides a measure of the water content of the palmyra spongy endosperm powder and for that matter its total solid content (Vijaya kumari *et al*., 2014). Moisture affects the physical, chemical aspects of food which relates the freshness and stability for the storage of the food for a long time. So moisture content is important in determining the shelf life. The lower the moisture content, the better its shelf stability (Mulvaney, 1995; Isengard, 2001). The Ph is 7.0, i.e neutral pH.). The foods contain high pH values are more susceptible to microbial spoilage (Richard and St.Piere, 2006).

The ash content is 5g. The Ash content of a food sample is the residue of the remaining after the complete removal of moisture and organic matter has been burned away at 600˚C. The TSS is 6 ◌Brix. The protein content of the Palmyrah spongy endosperm powder is 5.4%. Proteins are the essential nutrients for the human body. Proteins are also served as a fuel source (Young, 1994).The major component of the Palmyrah spongy endosperm powder is carbohydrate. The total carbohydrate is 70%. These are the compounds providing the energy needed to operate and maintain muscle cells, brain, red blood cells, etc. (Martin, 2000). The fat content is 2.1g. The fat provides more than half of the body's energy needs (Erika Gebal, 2011). The Palmyrah spongy endosperm powder also contains the minerals like calcium 265mg, Iron 4mg and phosphorus 0.29g. Minerals facilitate the transfer of nutrients across the cell membranes. The minerals have great importance for human consumption (vijaya kumari *et al*., 2016). No single mineral can function without the others, since they are synergistically released. Minerals are the electrolytes in the body. (Sonni Alvarez and Dos.MN, 2002).

Parameter	Average mean Values/ 100g
pH	7.0
Total soluble solids (%Brix)	6.0
Moisture (%)	5.5
Ash (%)	5.0
Protein (%)	5.4
Fat (%)	2.1
Total carbohydrates (%)	70
Calcium (mg)	265
Iron (mg)	4
Phosphorus (mg)	290
Energy (Kcal 100 g-1)	320.5 k.cal

Table 1: Physicochemical properties of Palmyrah Spongy Endosperm flour.

Functional properties

The water absorption capacity of the Palmyrah spongy endosperm powder is 2.8%. Water absorption capacity describes pulp-water association capacity under limited water supply. The oil absorption capacity is 1%. Bulk density is 56 gcm^{-3}. This value depends upon the particle size of the sample and is a measure of heaviness of the sample. Increase in bulk density is desirable in that it offers greater packaging advantage, as a greater quantity may be packed within a constant volume (Fagbemi, 1999).The swelling power of the Palmyrah spongy endosperm powder value is $6.9gg^{-1}$. Food eating quality is often connected with the retention of water in the swollen starch granules (Rickard *et al.*, 1992). The foam capacity is 5% and the form stability is 20min. Foam ability is reported to be related to the amount of solubilised protein (Lin *et al.*, 1974; Naraya and Narasinga Rao, 1982).

Parameter	Values
Water absorption capacity (%)	2.8
Fat or Oil absorption capacity (%)	1.0
Bulk density (gcm^{-3})	56
Swelling power (gg^{-1})	6.9
Foam capacity (%)	5

Table 2: Functional properties of Palmyrah Spongy Endosperm powder.

Qualitative Phytochemical Screening

The qualitative phytochemical screening of the Palmyrah spongy endosperm powder shows the presence of Glycosides, Flavonoids, Phenols, Saponins, and absence of Tannins, Alkaloids.

Phytochemicals	Ethanolic extract
Carbohydrates Anthrone test	present
Amino acids Ninhydrin test	present
Flavonoids Alkaline Reagent test	present
Saponins Froth test	present
Phenolic compounds Lead acetate test	present
Glycosides	present
Alkaloids Mayer's test	Absent
Tannins Ferric chloride Test	Absent

Table 3: Phytochemical screening of palmyrahSpongy Endosperm powder.

Glycosides have been known to lower blood pressure (Watt *et al.*, 1984). Flavonoids are a group of polyphenolic compounds. They also act as anti-allergic, anticancer anti-neoplastic activity, and for the treatment of intestinal disorders. (Rievere *et al*., 2009). Phenolic compounds acts as a cellular support material. Bioactive polyphenols have attracted special attention because they can protect the human body from the oxidative stress which may cause many diseases, including cancer, cardiovascular problems and ageing (Robards *et al*., 1999). Saponins are generally regarded as antinutrients but are also thought to be useful in human diet for controlling cholesterol. Its presence, therefore might suggest that the Palmyrah spongy endosperm powder has medicinal value (vijaya kumari *et al*., 2015). Saponins act as bioactive antibacterial agents in plants are also used to treat hypercholesterolemia, hyperglycemia and obesity (Mohanta *et al*., 2007).

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