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Research Article

Utilization and Characterization of Moringa Waste (Drumstick Peel) and Evaluation of Its Functional Properties

Kota Lakshmi, Divya P., Asish Rawson and Suresh Kumar K.*

Indian Institute of Food Processing Technology, Pudukkottai Road, Thanjavur, Tamilnadu-613005, India

*Corresponding Author E-mail: sureshkumar.k@iifpt.edu.in

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ABSTRACT

A huge amount of waste is produced every year from the food sector in the form of peel, seed pomace and in other inedible forms. After suitable processing which can be utilized for food applications. Drumstick peel is an edible bio waste which is not used due to its rough texture and high fibre content. Drumstick peel powder was prepared through sequence of steps which include cutting, blanching, separation of peel and pulp, drying of peel and pulverization. Drumstick peel powder was subjected for proximate analysis and also determined the functional properties. Characterisation and identification of functional groups was determined by FTIR analysis. The peel contains very good nutritional composition includes crude fibre of 38.146±0.192%, carbohydrate content of 34.798±0.252%. FTIR analysis determined the presence higher quantity of cellulosic, hemicellulose and lignin etc., compounds. It also possesses the very good functional properties includes water absorption capacity of 5.182±0.02 g/g, oil absorption capacity of 2.915±0.066 g/g and swelling capacity of 11.34±0.16 ml. So, this study suggested that utilisation of moringa waste and its application in food product development.

Key words: *Moringa, peel, Functional properties, Proximate analysis, FTIR*

INTRODUCTION

Moringa belongs to the family moringaceae. It is a perennial tree with traditional medicinal and industrial uses. All parts of the moringa have specific use which includes leaves for biomass production, medicinal and culinary uses, bark for rope making, seeds for water purification and honey- sugar cane juice clarifier, pods used as vegetable, roots have medicinal properties[1]. Moringa can be used in different forms such as extracts, emollients, decoctions, porridges, creams, oils, poultices, salves, powders to prevent diseases or infections[2]. India possess first place in production of moringa tender fruits with 1.1 to 1.3 million tonnes per year with an area of 38,000 ha. In India both area and production wise Andhra Pradesh with 15655ha possess the first place followed by Karnataka with 10280 ha and Tamilnadu with 7408 ha.

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The intended end use of the final product depends on the stage at which the moringa fruits or pods are harvested[3]. Moringa fruits are also very good nutritional value such as carbohydrates, protein, polyphenols, fibre, calcium, phosphorus, iron, potassium etc[4].

The fundamental physio-chemical properties nothing but functional properties that reflect the complex interaction between the molecular conformation, composition and structure of compounds[5]. Functional properties of sample required to evaluate to identify how new proteins, carbohydrates, fibre, fat may behave in specific systems[6]. Physio- chemical properties includes such as colour, water activity (a_w), PH, water absorption capacity, oil absorption capacity, hydration, swelling capacity, bulk density, foaming capacity and emulsion activity. These characters were affected by many factors such as particle size, nature of the sample etc.,

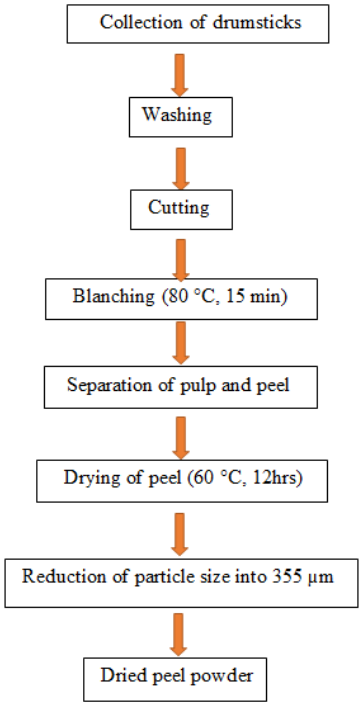
Previously many studies have been studied on the moringa which includes extraction of immunoenhancing polysaccharide from the mature pods of the *moringa olifera*[7], moringa peel extract was used in synthesis of ZnO particles[8], moringa peel also have a very good antimicrobial activity[9]. Now days soup mix was prepared from wide verities of vegetables, mushrooms, moringa leaves, fish, legumes etc[10,11,12]. Debittered moringa seed powder used as supplement in soup mix[13].

The main objective of this study is to increase the utilization of moringa waste to reduce environmental pollution and to determine the usage of drumstick peel application in food product by analysing functional properties.

MATERIALS AND METHODS

Materials: Drumsticks, tray drier, pulverizer, Electronic balance, muffle furnace, digestion unit and distillation unit for protein analysis by kjeldal method, soxhlet extractor, hot air oven, pH meter, colorimeter, water activity meter.

Drumstick peel powder preparation (DPP):



Proximate analysis: All the proximate parameters were analysed for drumstick peel powder according to the AOAC method 2005 (association of official analytical chemists). By using hot air oven at 130°C for 2h, kjeldal method, Soxhlet apparatus, muffle furnace at 550°C for 5h (923.03 AOAC) moisture, protein, fat and ash was analysed respectively.

Crude fibre was analysed by acid digestion of sample followed by alkali digestion.

Functional properties of drumstick peel powder:

Determination of the functional properties of the sample will provide the suitable application of it into food product. So, the following functional properties were determined for drumstick peel powder.

Bulk density (BD)

Volume occupied by the known weight of the sample will give the bulk density of sample.

$$\text{Bulk density (g/ml)} = \frac{\text{Wt. of sample}}{\text{Volume of sample}}$$

Water absorption capacity (WAC)

30ml of distilled water was added to the 1g of sample in a pre-weighed centrifuge tubes then placed in shaking water bath at 30 °C for 30min. Than mixture was centrifuged for 10min at 5000×g. supernatant was decanted then weight of the residue was taken. Each test carried out in triplicates and averages were taken. The WAC was calculated by using following equation.

$$\text{WAC (g/g)} = \frac{\text{Wt. of sediment with tube – wt. of tube}}{\text{Wt. of sample}}$$

Oil absorption capacity (OAC)

1g of sample was mixed with 10ml of oil in a pre-weighed centrifuge tube. Vortex for 10min to uniform mixing of sample then incubated for 30min. after that mixture was centrifuged at 3000 rpm for 10mins. Then supernatant was carefully removed and weight of residue was taken. Each test carried out in triplicates and averages were taken. The OAC was calculated by using following equation.

$$\text{OAC (g/g)} = \frac{\text{Wt. of the residue}}{\text{Wt. of sample}}$$

Swelling capacity (SC)

At room temperature 10 mL of distilled water was added to the 1.0 g of Sample in a graduated test tube kept aside for 18 h. Before addition of water and after 18h of time period the volume occupied by the sample in graduated test tube was taken. Each test was carried out in triplicate, and averages were taken. SC was calculated by using following Eq.

$$\text{Swelling capacity (mL/g)} = \frac{V_1 - V_0}{M}$$

where V_0= volume of sample before addition of water (mL), and V_1 = volume of sample after 18h of addition of water, m = initial weight of sample taken (g).

Emulsion capacity (EC):

10ml of distilled water and 10ml of vegetable oil was added to the 1g of sample in a graduated centrifuged tube. The mixture was vortex for 10 mins for uniform mixing then centrifuged for 5 min at 2000 rpm. Height of the emulsion layers and whole layer was taken. Each test was carried out in triplicate, and averages were taken. EC was calculated by using following Eq.

$$\text{EC (\%)} = \frac{\text{Height of the emulsified layer}}{\text{Height of the whole layer in tube}} * 100$$

Foaming capacity (FC):

50ml of distilled water was added to the 1g o sample in a graduated tube at 30±2 °C. The suspension was shaken for 10 min to develop foam. Volume of the foam was recorded after 30sec it will provide the stability of the foam. Each test was carried out in triplicate, and averages were taken. FC was calculated by using following Eq.

$$\text{Foaming capacity (\%)} = \frac{\text{Volume of foam after whipping - Volume of foam before whipping}}{\text{Volume of foam before whipping}} * 100$$

Physiochemical properties:

Colour, pH, water activity (a_w) of the sample was measured by using hunter lab colorimeter (model: colour quest XE, U.S.A), pH meter (LAQUA-PH1100, Horiba scientific) and dew point hygrometer (Aqua lab series 4TE) respectively.

Fourier transform infrared spectroscopy (FTIR):

Characterisation and identification of functional groups present in the drumstick peel powder was done by using FTIR (perkin elmer instrument, model spectrum two).

RESULTS AND DISCUSSION

Proximate analysis: The proximate composition of drumstick peel powder was done according to the AOAC method. The values were shown in table 1. Moisture content of the powder dried up to 7.778±0.113 % so it can be stored for long time without any spoilage. Fat present in the sample was very low (2.744±0.103 %) generally fruit and vegetables have very lower content of fat. Drumstick peel powder contains large amount of crude fibre (38.146±0.192%) followed by carbohydrate content (34.503%). Presence of high amount of crude fibre content is may be due to the presence of lignocellulosic, hemicellulose compounds present in the drumstick peels. As the maturity of the pods increases the fibre content of the pods also increases so the fruits become tender[14]. Because of presence of high fibre content, it can be used for development of fibre enriched products.

Functional properties: Functional properties describes the how sample behaves the during cooking, processing and preparation how it affects the end food product in terms of it taste, appear and consistency. Functional properties of the drumstick peel powder were shown in table2. Water absorption capacity (5.182±0.02 g/g) of the higher than oil absorption capacity (2.915±0.066 g/g). water and oil absorption capacity were indicated by ability of protein to bind water molecule, carbohydrates also influence the water absorption capacity and it was very important property for product consistency and bulking as well as in baking applications[15,16]. The protein present in the sample has the ability to bind with oil makes it useful in food products. The oil absorption capacity of the sample also helping in mouth feel and flavour enhancement when used in food applications. The bulk density of the sample was reported as 0.291±0.014 (ml/g), it provides the information about volume and strength of required packaging material. Considerable amounts of emulsifying activity of drumstick peel powder was observed (13.386±0.173 %). This might be due to the protein present in the sample which contributes to hydrophobicity. Emulsion activity also depends on the fat content of the sample[17]. The foaming capacity of the DPP was observed to be 2.543±0.047 %. This may be attributed due to the protein content which reduces the surface tension between air and water and thus helps in the formation of foam[18].

Physio chemical properties: Colour of the DPP was measured by using colorimeter it was recorded as (L – 62.693±0.073, a – 1.26±0.06, b – 18.60±0.04). water activity of the DPP was recorded as 0.577±0.012 at 26.31 °C. This will provide the storage of the DPP for long time without any microbial spoilage. The pH of the

DPP is 4.046±0.041. This pH is slightly acidic so, it will not suitable for microbial growth. So, the physio chemical properties of the sample provide information about the storage stability and appearance of the product.

FTIR analysis: The characterisation, structural composition and functional groups present in the drumstick peel powder was identified by FTIR technique. FTIR peak numbers and their corresponding transmittance was represented in table 3. From the FTIR spectra, the adsorption band of the DPP ranged from 1029 cm^{-1} to 404 cm^{-1}. The peak at 1029.31(cm^{-1}) includes a C-C, C-OH, C-H ring and side group vibrations, at 667.4 cm^{-1} include C-OH group out plane bending and S-CN stretching vibrations in cellulose. The wave numbers at 495 cm^{-1} to 404 cm^{-1} includes SCN group in-plane deformation vibration[19].

Table 1: proximate composition

S. No	Proximate composition	Content (%)
1.	Moisture	7.778±0.113
2.	Crude protein	12.153±0.160
3.	Crude fat	2.744±0.103
4.	Crude fibre	38.146±0.192
5.	Ash	4.38±0.105
6.	Carbohydrate	34.798±0.252

Table 2: Functional properties

S. No	Parameter	Data
1.	Bulk density	0.291±0.014 (ml/g)
2.	Water absorption index	5.182±0.02 (g/g)
3.	Oil absorption index	2.915±0.066 (g/g)
4.	Swelling capacity	11.346±0.167 ml
5.	Emulsion capacity	13.386±0.173 (wt./vol)
6.	Foaming capacity	2.543±0.047 %

Table 3: FTIR peak table

Peak no.	X (cm^{-1})	Y (%T)
1.	1029.65	82.99
2.	667.4	86.77
3.	588.71	88.37
4.	573.74	89.26
5.	546.87	87.56
6.	531.24	91.66
7.	495.81	90.36
8.	472.74	87
9.	452.54	85.34
10.	436.19	85.94
11.	418.1	63.22
12.	404	78.03

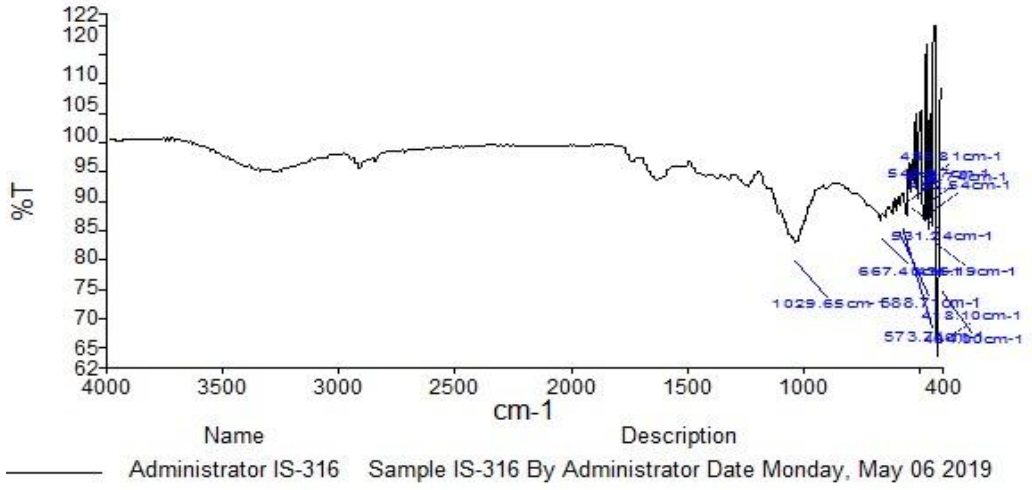


Fig. 1: FTIR Peak

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