A DISSERTATION ON

Valorization of Jackfruit Peel into Burger Patties

SUBMITTED TO THE

DEPARTMENT OF BIOSCIECES

INTEGRAL UNIVERSITY, LUCKNOW

IN PARTIAL FULFILMENT

FOR THE

MASTER DEGREE OF SCIENCE

IN BIOTECHNOLOGY

BY

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M.sc Biotechnology

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UNDER THE SUPERVISION OF

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DECLARATION FORM

I, **Saurabh Bhardwaj**, a student of **M.sc BioTechnology** (II Year/ IV Semester), Integral University have completed my four months dissertation work entitled **"Valorization Of Jackfruit Peel into Burger Patties"** successfully from **Integral University, Lucknow** under the able guidance of **Er. Poonam Sharma**, Department of Bioengineering, Integral University Lucknow.

I, hereby, affirm that the work has been done by me in all aspects. I have sincerely prepared this project report and the results reported in this study are genuine and authentic.

Saurabh Bhardwaj

Date:

Dr M. Salman Khan

(Course Coordinator)

Date

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CERTIFICATE

Certificate That **Mr Saurabh Bhardwaj** (Enrollment Number 1700100070) has carried out the research work presented in this thesis entitled **"Valorization of Jackfruit Peel into Burger Patties"** for the award of **M.sc BioTechnology** from Integral University, Lucknow under my supervision. The thesis embodies results of original work and studies carried out by the student himself and the contents of the thesis do not form the basis for the award of any other degree to the candidate or to anybody else from this or any other University/Institution. I wish him good luck and bright future.

Er. Poonam Sharma
(Supervisor)
Assistant professor
Department of Bioengineering

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TO WHOM IT MAY CONCERN

This is to certify that **Saurabh Bhardwaj,** a student of **M.sc BioTechnology** (II Year/ IV Semester), Integral University has completed his four months dissertation work entitled "**Valorization of Jackfruit Peel into Burger Patties**" successfully. he has completed this work from Integral University under the guidance of Er. Poonam Sharma. The dissertation was a compulsory part of his M**.sc BioTechnology degree.**

I wish him good luck and bright future.

Dr. Snober S. Mir
Head of Department of Biosciences
Faculty of Bioscience

ACKNOWLEDGMENT

I would like to express my deep sense of gratitude to ***Er. Poonam Sharma*** *(Department of Bioengineering) for their invaluable guidance throughout the course of my dissertation work and academic session. It would have been impossible to complete this work in so short a time without her constant guidance. I wish every trainee and research student were fortunate enough to have such an affectionate guide.*

I would like to express my sincere thanks to ***Dr. Snober S Mir*** *(Head of Department of Biosciences) for giving me an opportunity to join the department laboratory and providing all the necessary facilities since I started my work.*

I gratefully acknowledge to ***Dr. M. Salman Khan (Department of Bioscience,) Priyanka Dubey(Lab Incharge)*** *who inspired and encouraged me during various steps of my work although they were busy with their daily tasks but always were available to answer my questions and clear all my doubts.*

My gratitude also goes to all my friends who were fundamental in supporting me during this course of thesis.

My acknowledgment will be incomplete if I do not mention my parents with whose blessing I was able to achieve my goal successfully. There are no words to express my feelings toward them. I silently acknowledge my debt to them.

Saurabh Bhardwaj

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1. INTRODUCTION

Artocarpus heterophyllus which is commonly known as jackfruit is a tropical climacteric fruit, belonging to Moraceae family, is native to Western Ghats of India and common in Asia, Africa, and some regions in South America. It is known to be the largest edible fruit in the world. Jackfruit is rich in nutrients including carbohydrates, proteins, vitamins, minerals, and phytochemicals. Both the seeds and the flesh of jackfruit are consumed as curries and boiled forms, while the flesh in fully ripen stage can be eaten directly as a fruit. Several countries have developed different food products such as jam, jellies, marmalades, and ice creams using pureed jackfruit. The several parts of jack tree including fruits, leaves, and barks have been extensively used in traditional medicine due to its anticarcinogenic, antimicrobial, antifungal, anti-inflammatory, wound healing, and hypoglycemic effects. Despite all these benefits, unfortunately, the fruit is underutilized in commercial scale processing in regions where it is grown. The aim of this review is to disseminate the knowledge on nutritional and health benefits of jackfruit, in order to promote utilization of jackfruit for commercial scale food production(R.A.S.N Ranasinghe 2019)

1.2 From Waste To High Value Products(Valorization)

Waste valorization is the process of reusing, recycling or composting waste materials and converting them into more useful products including Food Products, chemical, fuels or Other Source Of Energy.

All of this food waste contains compounds that have high-value potential applications. Some can act as prebiotics or anti-oxidants; some have anti-inflammatory or anti-microbial properties; others, in particular carbohydrates, provide mechanical strength and texturising properties in food, lubricants, cosmetics and structural materials.

Food production and processing in developing countries generate high levels of waste and byproducts, causing a negative environmental impact and significant expenses. However, these biomaterials have ample potential for generating food additives which in turn will minimize malnutrition and hunger in the developing countries where it is produced.

Many of these biomaterials are a source of valuable compounds such as proteins, lipids, starch, micronutrients, bioactive compounds, and dietary fibers. Additionally, antinutritional factors present in some byproducts can be minimized through

biotechnological processes for use as a food additive or in the formulation of balanced foods.(Ayala et al.,2011)

We Plan To Increase The Value Of Plant Waste And make Nutritional Products For Human Beings

2. Review of Literature

Fiber

Fiber is simply a type of carbohydrate found naturally in plant-based foods that is not digestible in humans. Plant-based foods that are rich in fiber — such as fruits, vegetables, whole grains, beans and legumes, and nuts and seeds fiber cannot be digested, it is being moved down the digestive tract as nutrients are being digested, and can do some great things that positively impact our health There are two types of fiber: soluble and insoluble. both are important

(A) Soluble Fiber

Soluble fiber is a type of fiber that attracts water and forms a gel. This gel causes a slowing of the digestion process, which can be beneficial for weight loss. Foods high in soluble fiber include oats, legumes, edible plant skins, and nuts

(B) Insoluble Fiber

insoluble fiber in foods such as veggies, fruits, nuts and seeds, wheat bran, and whole-grain foods like whole-wheat pasta and brown rice. Its primary benefit is to provide bulk to stool and aid in the movement through the digestive tract.
Most diets have a combination of soluble and insoluble fiber, with 75 percent coming from insoluble fiber and 25 percent coming from Soluble fiber

Health Benefits of The Fiber

higher intake of fiber tend to have lower rates of heart disease, obesity, type 2 diabetes, stroke, high blood pressure (hypertension), and digestive diseases.

Fiber help improve or prevent health conditions such as prediabetes, diabetes, high cholesterol, obesity, and various digestion problems, like constipation, colon cancer, and diverticulitis, by simply increasing fiber in your diet(Angela lemond 2019)

(a) Weight loss

Foods high in fiber also tend to be lower in energy density, meaning they'll help you feel fuller without consuming excessive calories. This concept is at the core of why a higher fiber diet is associated with a lower rate of obesity

(b) Digestive Disorders

One benefit of getting enough fiber in your diet is reducing the risk of diverticulitis, a condition in which pouches formed in the colon become infected. Fiber helps keep food clear from the pouches and moving through the digestive tract. Aim to take in 25 to 40 g of fiber per day to reduce your risk of diverticulitis

There is an anti-cancer benefit to fiber, too: Both soluble and insoluble fiber can also play a role in warding off colon cancer

(c) Cholesterol And Blood Pressure Reduction

Human body uses bile salts, which are excreted by the gallbladder to break apart the fat content in food. Bile salts are made of cholesterol

When you eat food with fiber, the fiber binds to the bile salts, preventing them from being recirculated for the next time you eat. As a result, your body must produce more bile salts by taking cholesterol from the liver. This is how soluble fiber reduces blood cholesterol

Fiber has a preventative role on blood pressure, too, but the reason is more associated with nutrients such as potassium, calcium, and magnesium contained food high in fiber.

jackfruit peel contains the high amount of cellulose (27.75%), pectin (7.52 ± 0.12 %), protein (6.27 ± 0.03%) and starch (4%) of 85% crystallinity, indicated typical cellulose I form inferring higher crystallinity (pathak,pd2014)

Jackfruit peel, also known as rind or skin, is the outer protective layer of the fruit which consists around 40.05% in Khaja, Gala, and Durasha variety respectively (Anonymous,)1996). The unsystematic disposal of peel imposes a serious burden on the environment.

However, proper utilization of the by-products not only increases the economic value but also reduces the cost of disposal. Jackfruit peel is reportedly rich in cellulose, pectin, protein,

and starch comprising about 27.75%, 7.52%, 6.27%, and 4%, respectively (Sundarraj and Ranganathan, 2017).

Central core or axis of jackfruit

Subburamu et al. (1992) prepared a meal from the jackfruit central core and found carbohydrate(20.5%), crude protein (10.6%), and crude fibre (15.9%) are the principal proximate compositions.

Utilization of non-edible wastes

Animal feed

jackfruit peel as a valuable raw material for the cattle feed as this is a rich source of carbohydrate, protein, and fiber containing 24%, 8.7%, and 17.3%, respectively. Ajey (2013) studied on jackfruit waste for the nutrient-enriched animal feed by supplementing nitrogen and fermenting with yeast (S. boulardii) and LAB (L. acidophilus).

The results revealed that the jackfruit waste feed supplemented with 2% ammonium sulphate and fermented by combined yeast and LAB recorded the highest crude protein (22.34%) and crude fibre (23.37%). The developed feed from jackfruit waste in the form of dried powder contained moisture 5.42%, carbohydrate 71.40%, protein 23.81%, crude fibre 22.63%, crude fat 6.37%, and ash 6.5%(Subburamu et al 1992)

Bio-fuel

extracted bio-oil from the jackfruit peel waste by pyrolysis process in a fixed bed reactor and investigated the extracted oil. After pyrolysis in a range of high temperatures (400-700oC) they found that the peel contains high amount of volatile compounds which indicates this biomass as a suitable precursor for bio-oil production

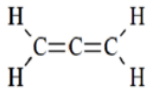
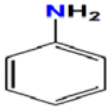
Low sulphur (0.03%) and nitrogen (0.61%) contents were the strong indication to be environmental friendly bio-oil. The study found the best quality bio-fuel at the temperature of 550 oC with the highest organic content (85.2%) and the lowest water content (14.8%). On the other hand, Yuvarani and dhas (2017) extracted bio-ethanol (oxygenated fuel) from jackfruit peel by fermentation using SaccharomycesCerevisiae yeast as a microorganism. The main types of raw materials for ethanol production using biological method were cellulose, carbohydrate and sugar

The effect of various parameters such as composition of jackfruit peel, temperature, shaking rate, fermentation time, and nutrients were studied and the optimum conditions were obtained. The result showed that the ethanol extraction was increased by increasing the jackfruit peel composition and decreased by increasing the temperature (Soetardji et al.2014)

2.2 Contents of Jackfruit Peel

Ethanolic and methanolic extracts of Jackfruit peels were investigated. The phytochemical screening revealed that the presence of alkaloids, flavonoids, carbohydrates, proteins and triterpenoids the active compounds(allwyn sundarraj2017)

Chemical Elements / minerals	mg / L (or) ppm
Silica (Si)	0.24
Aluminum (Al)	2.16
Cadmium (Cd)	0.001
Calcium (Ca)	30.445
Chromium (Cr)	0.027
Cobalt (Co)	0.008
Copper (Cu)	0.735
Iron (Fe)	4.184
Lead (Pb)	0.28
Manganese (Mn)	1.873
Nickel (Ni)	0.118
Silver (Ag)	1.071
Zinc (Zn)	0.9982

Compounds	Assignments	ppm (Chemical Shift)	Carbon Environment	Functional Group
n- Butylamine	$CH_3CH_2CH_2CH_2NH_2$	δ42.18	Alkyl Chlorides (RCH_2Cl); (40 - 45 ppm)	Alkyl group and Sp3 Hybridization
Methoxide	CH_3O	δ59.43 δ59.60	Methanamine or amide (RCH_2NH_2); (30 - 65ppm)	Alkyl or Aryl group and Sp3 Hybridization
Methyl ether Methanol	Me_2O CH_2OH	δ61.22 δ62.21 δ62.73	Primary Alcohol (RCH2OH); (60 - 70 ppm)	Carbon bearing OH group and Sp3 Hybridization
Methylene	CH2	δ66.40	Alkynes *(R-C≡C-R);* *(65 - 85 ppm)*	Alkyl group and Sp3 Hybridization
2-Methyl-2-Propanol	Me_3COH	δ70.29 δ70.32	Primary Alcohol (RCH2OH); (60 - 70 ppm)	Carbon bearing OH group and Sp Hybridization
1, 2-dimethoxyethane	$CH_3OCH_2CH_2OCH_3$	δ71.61 δ72.98	Alkynes *(R-C≡C-R);* *(65 - 85 ppm)*	Alkyl group and Sp Hybridization
tertbutyl methyl ether	(CH3)3COCH3	δ73.29		
1,2-propene		δ74.23 δ74.60 δ74.80		
Hexane	CH3[CH2]4CH3	δ127.91	Trans - Alkene (RCH=CHR); (120 - 140 ppm)	Alkyl (or aromatic) group attached to a carbonyl function and Sp2 Hybridization
Nitrile	R—C≡N	δ145.31	Aromatic Rings C (125 = 150 ppm)	Alkyl or aromatic group and Sp2 Hybridization
Carboxylic amides		δ164.09	Amide($RCONR_2$); (160 - 180 ppm)	Alkyl or aromatic group and Sp2 Hybridization
Carboxylic acids	O ‖ /C\		Carboxyl(RCOOH); (160 - 180 ppm)	
Ketones	O ‖ /C\ R R	δ197.51	Carbonyl (RCOR'); (190 - 205 ppm)	Alkyl or aromatic group and Sp2 Hybridization
Aldehydes	O ‖ /C\ R H		Aldehyde (RCHO); (190 - 205 ppm)	

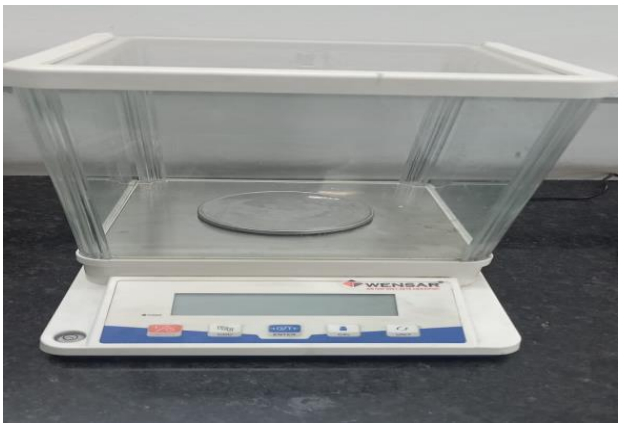
(Ref; (39); (40); (21) - Identification of various compounds in ^{13}C NMR).

2.3 Laboratory Equipments

Weighing scale

Weighing balances are tools used to measure the mass of samples. They measure samples based on various principles depending on the precision required. Spring balances measure mass by measuring the weight by balancing the force due to gravity against the force on a spring.

These are mechanical scales which measure the mass, force exertion, tension and resistance of a sample without requiring a power supply. Other mechanical scales include hanging scales, triple beam scales, force gauges etc. Analytical balances are laboratory tools which can measure objects accurately in the sub-milligram range. These devices measure the force needed to counter the mass being measured, instead of directly measuring the objects. Electromagnets are used to generate the force to counter the samples. These balances are enclosed in a chamber hood to protect the weighing process from external factors such as dust, air currents, humidity etc.



Grinder

A grinder-mixer is used in food tech lab the machine used to process livestock feed from grain. A grinder-mixer is a portable mill that combines the mixing and grinding operations.

Grinding of ingredients generally improves feed digestibility, acceptability, mixing properties and pelletability.

Muffle Furance

The inorganic residue left by ignition or complete oxidation of an organic substance in a food sample is known as Ash.

Analysis of nutritional evaluation is done by determining the ash content of the food. Ashing is the primary step while preparing a sample for elemental analysis.

The dry ashing method with a Muffle Furnace determines the ash content of a variety of food products.

Hot Air Oven

Hot air ovens are electrical devices which use dry heat to sterilize. They were originally developed by Pasteur.

Generally, they use a thermostat to control the temperature. Their double walled insulation keeps the heat in and conserves energy, the inner layer being a poor conductor and outer layer being metallic.

There is also an air filled space in between to aid insulation. An air circulating fan helps in uniform distribution of the heat. These are fitted with the adjustable wire mesh plated trays or aluminium trays and may have an on/off rocker switch, as well as indicators and controls for temperature and holding time.

The capacities of these ovens vary. Power supply needs vary from country to country, depending on the voltage and frequency (hertz) used. Temperature sensitive tapes or biological indicators using bacterial spores can be used as controls, to test for the efficacy of the device during use.

Desiccator

containing desiccants used for preserving moisture-sensitive items such as cobalt chloride paper for another use. A common use for desiccators is to protect chemicals which are hygroscopic or which react with water from humidity

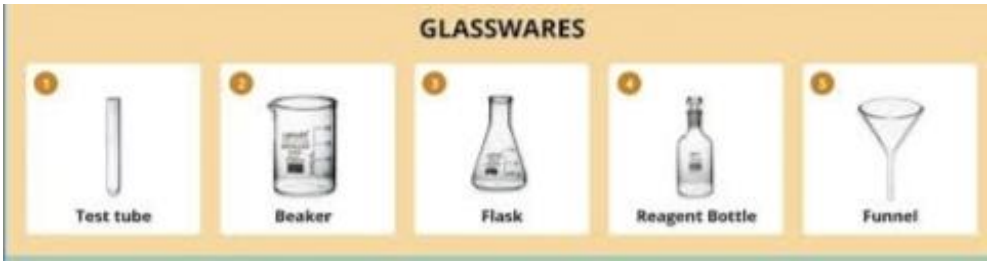
The contents of desiccators are exposed to atmospheric moisture whenever the desiccators are opened. It also requires some time to achieve a low humidity. Hence they are not appropriate for storing chemicals which react quickly or violently with atmospheric moisture such as the alkali metals; a glovebox or Schlenk-type apparatus may be more suitable for these purposes.

Desiccators are sometimes used to remove traces of water from an almost-dry sample. Where a desiccator alone is unsatisfactory, the sample may be dried at elevated temperature using Abderhalden's drying pistol

2.4 APPARATUS USED

Glass Ware

Laboratory glassware refers to a variety of equipment used in scientific work, and traditionally made of glass. Glass can be blown, bent, cut, molded, and formed into many sizes and shapes



Safety Equipments

Due to the presence of many potentially harmful chemicals and pieces of equipment, laboratory settings come with certain safety risks. Common lab injuries include burns, lacerations, and chemical irritation and inhalation

it's important for lab staff and researchers to take certain lab safety precautions

3. MATERIAL AND METHODS

3.1 Raw Material Collections

Jackfruit Peel Were Collected From The local Market of Lucknow (District), Utter Pradesh, India

3.2 Preparation of Mashed Potatoes

Taking 500gm of Yukon gold potatoes wash it properly In pressure cooker adding potatoes and 150 ml of normal water place the pressure cooker on gas stove at medium flame wait upto two to three whistles then it becomes boiled. Take out all the boiled potatoes from pressure cooker and keep it cool. Removes all the potatoes peels and mash it with the help of masher

3.3 Preparation of Peel Paste

Cut the peel of jackfruit into small pieces, put 30 percent of the peel's weight in clean water.

Put it in a pressure cooker on medium flame, then after 2 whistles, when it cools down, take it out and grind it well in the grinder. Jackfruit peel paste is now ready.

3.4 Preparation of Spices

Firstly, in a heavy-bottomed pan take ¾ cup coriander seed and roast on low flame. Roast until the spices turn aromatic. keep aside.
in the same pan add ½ cup cumin, 1 tsp caraway and roast on low flame. roast until it turns aromatic. keep aside.further, take 2 tbsp pepper and 3 dried red chilli. roast until the chilli turns crisp. keep aside.now add 5 star anise, 3 inch cinnamon, 2 mace, 5 black cardamom, 2 nutmeg, 3 tsp cardamom, 1 tbsp clove, 2 tsp fennel and 5 bay leaf. roast until all the spices turn aromatic without burning. keep aside. cool all the spices and transfer to the mixer grinder also, add 1 tsp ginger powder and blend to a coarse powder.

Nutritions

Calories:		1kcal
Carbohydrates:		1g
Protein:		1g
Fat:		1g
Saturated	Fat:	1g
Sodium:		1mg
Potassium:		6mg
Fiber:		1g
Sugar:		1g
Vitamin	A:	4IU
Vitamin	C:	1mg
Calcium:		3mg

Iron: 1mg

3.5 Preparation of Bread crumbs

Take 10 pieces of breads blend them in a mixer to a fine coarse powder

Nutrient Values per cups

Energy	490 cal
Protein	15.6 g
Carbohydrates	103.8 g
Fiber	0 g
Fat	1.4 g
Cholesterol	0 mg
Sodium	0 mg

3.6 Preparation of Burger Patties

After the making of jackfruit peel paste,mashed potatoes and all the spices etc. Take 54gm of mashed potatoes and 36 gm of jackfruit peel paste mixed it properly Add 2gm white salt,1.5gm spices,0.5gm red chilli powder,9gm cornflour,two small piece cutting coriander leaves. Mixed all properly Make a pattie ball and put the pattie ball in pattie maker 1inch. Pattie thickness is the ideal size of a burger pattie 50gm refined wheat flour(maida) add 80ml of fresh water make maida water paste.

The burger pattie dipped into the maida water paste for 3 to 5 seconds after that remove it and spread bread crumbs all over the burger pattie

Take medium size of cauldron(metal pan) add 200 ml vegetable oil into the cauldron

Put it on gas stove and wait till oil become hot(80-90oC) after that burger pattie add in the cauldron carefully

It will takes 12 to 15 seconds

Take out the pattie from cauldron and place in the clean plate. Pattie covered with a tissue paper to remove outer oils

Now the nutritional burger pattie is ready

(A) Moisture Analysis

Heating whole sample in a hot air oven is the most widely used method for moisture content determination

Air-dry and grind sample Using 2- to 5-gm portion of ground air-dried sample

Calculate total moisture loss

To obtain percent of total solids in fresh loaf, subtract percent total moisture from 100.

Take 5gm sample in petri plate and put it in hot air oven at 110 oC temp. for 4 hours

After that measure the weight of sample and calculate the moisture by using given formula-

$$\text{Moisture content}(\%) = \frac{\text{Loss in weight of sample}(g)}{\text{Initial weight of sample}(g)} \times 100$$

(B) Ash Content

The empty weight of crucible was taken. Put 5gm of every sample in the crucible and placed into muffle furnace at 550oC temp. for 5 hours

The crucibles were removed from the furnace and placed in the desiccators to cool the samples. The weight was taken of every sample

The crucibles were removed from the furnace and placed in the desiccators to cool the samples. The weight was taken of every sample

Calculate the ash content by using following formula-

$$\text{Ash content}(\%) = \frac{\text{Weight of ash}(g)}{\text{Initial weight of sample}(g)} \times 100$$

(C) Sensory Evaluation

Sensory evaluation is an analytic tool to understand what individuals perceive in grain-based products.

Sensory evaluation can be divided into difference tests, affective (consumer) tests, and descriptive analysis (trained panels)

Sensory evaluation tests must be set up in a specific way to minimize errors and biases during testing.

Sensory attributes including colour,flavour,texture,chewiness,fattiness,mouthfeel and overall acceptability

4. RESULTS AND DISCUSSION

Patties Preparation

The patties with different concentration of peel paste was prepared

The colour and taste varied with the composition of peel paste The colour and taste varied with the composition of peel paste

Increasing the peel paste the colour of patties become darker

Image showing the different colour of patties

Analysis Performed

(a) Moisture Content

The moisture content of patties ranged from 6.30 to 11.70%

The moisture content increased with increasing the peel paste

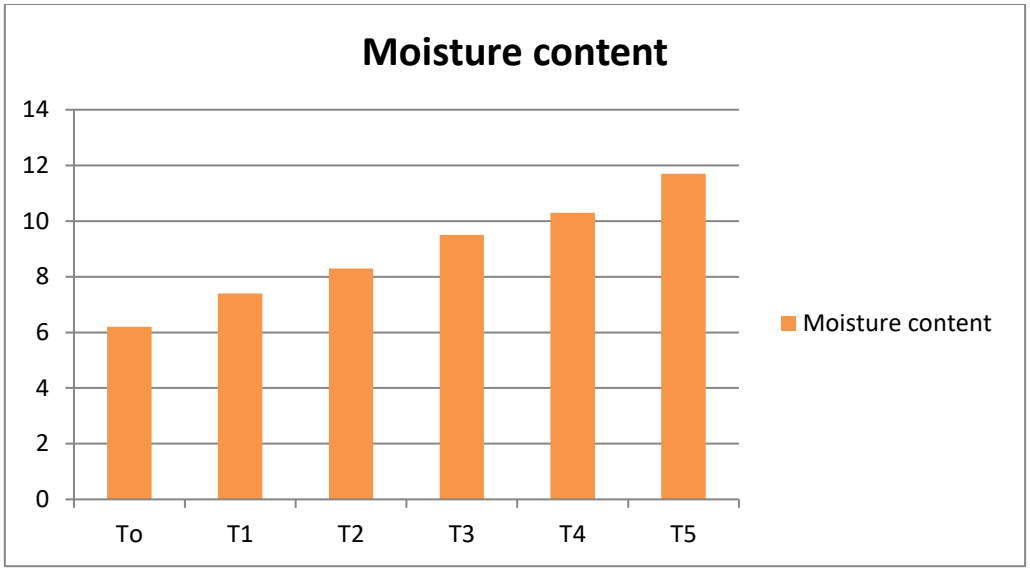


Fig. showing graphical representation of moisture content in patties

(b) Ash content

The ash content in peel paste patties is 4.98

The moisture content of patties ranged from 2.35 to 2.87%. The moisture content of patties increased with increasing the peel paste

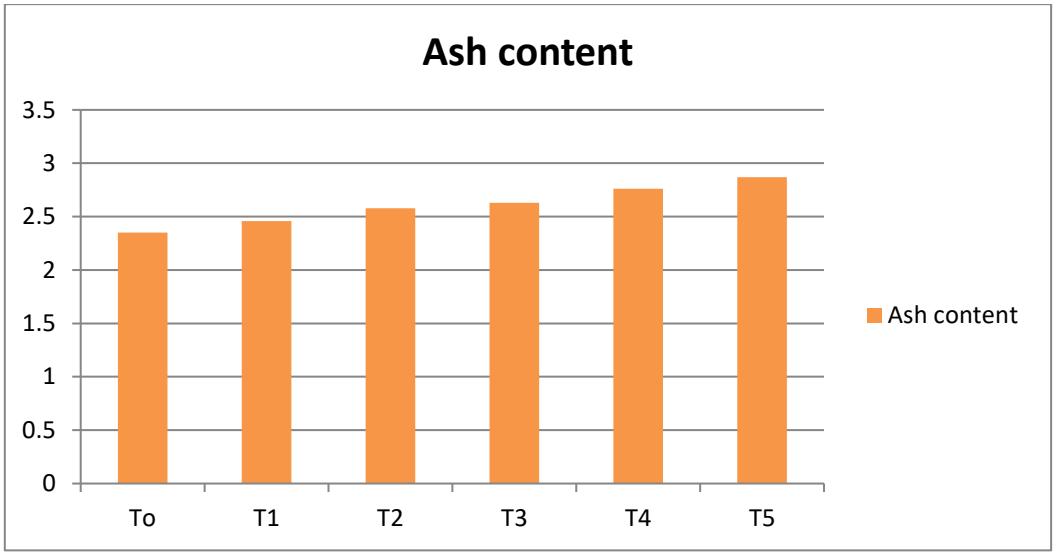


Fig. showing the graphical representation of ash content

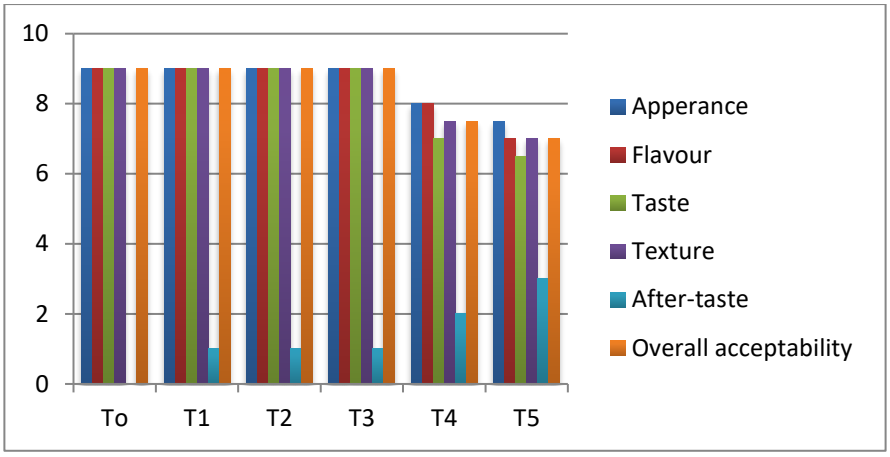
(c) Sensory evaluation

Sensory attributes of patties were evaluated at fresh condition using control and patties of different concentration of peel paste

Different attribute selected were colour, texture, taste, flavour, mouthfeel, chewiness and overall acceptability

The texture and taste was also affected with increasing the peel paste concentrate.

The overall acceptability of patties decreased with increasing the peel paste concentration.


10
8
6
4
2
0
To
T1
T2
T3
T4
T5
Apperance
Flavour
Taste
Texture
After-taste
Overall acceptability

5. CONCLUSION

The peels are considered waste and hence available an occasional price. Considering that the cellulose content is high as compared to the other naturally available source

The peel of jackfruit is a good source of fiber

For applications it is good source of nutritional human food

It’s a best way for the waste management system to use jackfruit peel as a food product

Help in to control Pollutions

Chemical elements and minerals like silica, aluminium, cadmium, calcium, cobalt, copper, iron, silver, zinc etc are present in jackfruit peel

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