PROTOTYPE OF VACUUM FRYING OYSTER MUSHROOM CHIPS

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ABSTRACT

Oyster mushroom is plant that is quite easy to cultivate because it only requires growing media for oyster mushrooms, oyster mushroom seeds and a humid place for cultivation. Oyster mushroom is a type of plant that is fibrous and contains a lot of water causing the shelf life of oyster mushrooms after harvest is very short. To increase the economic value of oyster mushrooms, it is necessary to process oyster mushrooms into something so that processed oyster mushrooms have a long shelf life, namely by processing oyster mushrooms into chips, but the manufacture of oyster mushroom chips still uses conventional or manual methods so that the quality of the resulting chips is still not good. By using innovative technology through a prototype design tool with the vacuum frying method, it produces chips that are of higher quality than conventional frying methods which are seen from the water content contained in oyster mushroom chips, which is less than 1% with an evaporated water content of 80%. The prototype of this vacuum frying fryer has an overall volume of 260,000 cm^3 with an overall length of 100 cm, a width of 40 cm and a height of 65 cm and uses an electric motor of 2461.76 watts or 3.3012 HP.

Keywords: Oyster mushroom; prototype; vacuum frying.

Introduction

Oyster mushrooms are one of the foodstuffs that are being demanded by the public, apart from being affordable, oyster mushrooms also have a delicious taste and lots of nutrients. This can be also be seen from the increasing demand every year. According to the Central Statistics Agency in 2017 the level of mushroom consumption in Indonesia reached 47,753 tons while its production was only 37,020 tons. Every year request oyster mushrooms increased by 10% for the needs of hotels, restaurants, vegetarians and others etc.[1] Because the market demand for oyster mushrooms is quite high and still cannot be fulfilled, making them bring in oyster mushrooms from outside area.

The growth period of oyster mushrooms is also quite fast in a period of 80 days starting from planting seeds until they are ready to harvest. Oyster mushrooms can be processed into various types of food, such as vegetables, side dishes, to snacks. One of them is processed into oyster mushroom chips.

Currently, there are still many who use the conventional frying method for processing oyster mushrooms into oyster mushroom chips so that the resulting chips are still not good, because it is necessary to design a tool that can process oyster mushrooms into healthy food, namely the vacuum frying system. In the process of frying oyster mushrooms under vacuum conditions there is heat transfer from hot oil to oyster mushrooms so that the water content in oyster mushrooms is reduced.

Under vacuum conditions, the frying temperature can be lowered to 70-85 due to the lowering of the boiling point of the oil. Thus, damage to the color, odor, taste and nutrition of the product due to overheating can be avoided. In addition, oil damage and other consequences caused by high temperatures can be minimized because the

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process is carried out at low temperatures and pressures.[2]

The initial dimensions of this vacuum fryer are 1200 x 1200 x 1100 mm with a capacity of 1 – 1.25 kg per process, using electric and gas stoves.[3]

As a support for the realization of the design into a machine that will be made, and based on the results of the calculations for the design of the vacuum frying tool includes: an aluminum frame, a production capacity of 4 kg, electric power requirements for a vacuum of 300 Watts, and use a gas stove.[4]

Based on the references of these journals, a prototype of a vacuum fryer (Vacuum frying) was designed which has a capacity of 8 liters of cooking oil, a capacity of 500 grams of mushroom frying for one frying pan, with time, temperature, pressure and a stirrer motor that can be adjusted according to needs.

Oyster Mushroom

Oyster mushroom or in another language called Pleurotus sp. It is a mushroom that belongs to the class Basidiomycetes which can be consumed and also has high economic value. Oyster mushrooms that are widely known in Indonesia in general include white oysters (Pleurotus ostreatus), this type of mushroom has a branched stem. It is called white oyster mushroom because the color of the mushroom is white, the hood is round 3-15 cm.[5]

Mushrooms contain 19-35 percent higher protein than protein on rice (7,38 percent) and wheat (13.2 percent), especially 72 percent unsaturated fat and content fiber from 7.4 to 24.6 percent very good for disgetion so it fits for dieters.[6]

Sawdust waste is a good substrate for growing white oyster mushrooms, which contains higher levels of lignin, silica, cellulose, hemicellulose, fiber, and ash than other media types.[7] In addition to wood sawdust, rice straw and corncob waste can also be used as media for the cultivation of white oyster mushrooms.[8]

Table 1. Composition and Nutritional Content of Osyter Mushrooms per 100 gr

Nutrients	Content
Protein	367 cal.
Calories	10.5-30.4%
Carbohydrate	56.6%
Fat	1.7-2.2%
Thiamin	0.20 mg
Riboflavin	4.7-4.9 mg
Niacin	77.2 mg
Potassium	314 mg
‘Ca (Calcim) K	3793 mg
P (Posfor)	717 mg
Na (Sodium)	837 mg
Fe (Iron)	3.4-18.2 mg

Source: Djarijah and Abbas 2001[7]

Prototype* of *Vacuum Frying

Prototype is the first model of the product that is used to test the concept or description of the idea. Prototypes have been used by many industries.[9] Before starting the design of the tool, first make a prototype or design a

small-scale tool. Meanwhile, tool design is very important in making a project, namely making large-scale tools.

The main components of vacuum frying are vacuum pumps, water pumps, frying tubes, water reservoirs, pressure gauges, condensers, electric motors, and spinners.

The function of this vacuum frying tool is to suck the water content in the fried ingredients at high speed so that the pores of the ingredients do not close quickly, so that the water content in the fruit can be absorbed perfectly. The working principle is to adjust the balance of temperature and vacuum pressure. To produce fruit chips products with good quality in terms of color, aroma, and taste do not change.

Oyster Mushroom Chips

Chips are foods that have the lowest water content (<3%) so that the shelf life can be longer than other types of processed foods. Chips are usually eaten as a snack (snack) which is quite popular in both the local and export markets.

Mushroom chips are one of the most popular processed mushroom products and are liked by many people. As a healthy snack, mushroom chips are made from consumption mushrooms which are rich in protein so as to produce high-quality processed food products. The savory and crunchy taste produced is usually mixed with flour dough that is given certain spices and fried using vegetable oil.

Methods

Time and Place

The implementation of vacuum frying and research was carried out from April to July 2021 at the Laboratory of the Chemical Engineering Department of the Sriwijaya State Polytechnic.

Design flow chart

The method in this research is design, which in the design process must pass the stages or design flow such as the flow diagram below, so that when the design process takes place it can be in accordance with the desired design and get maximum design results.

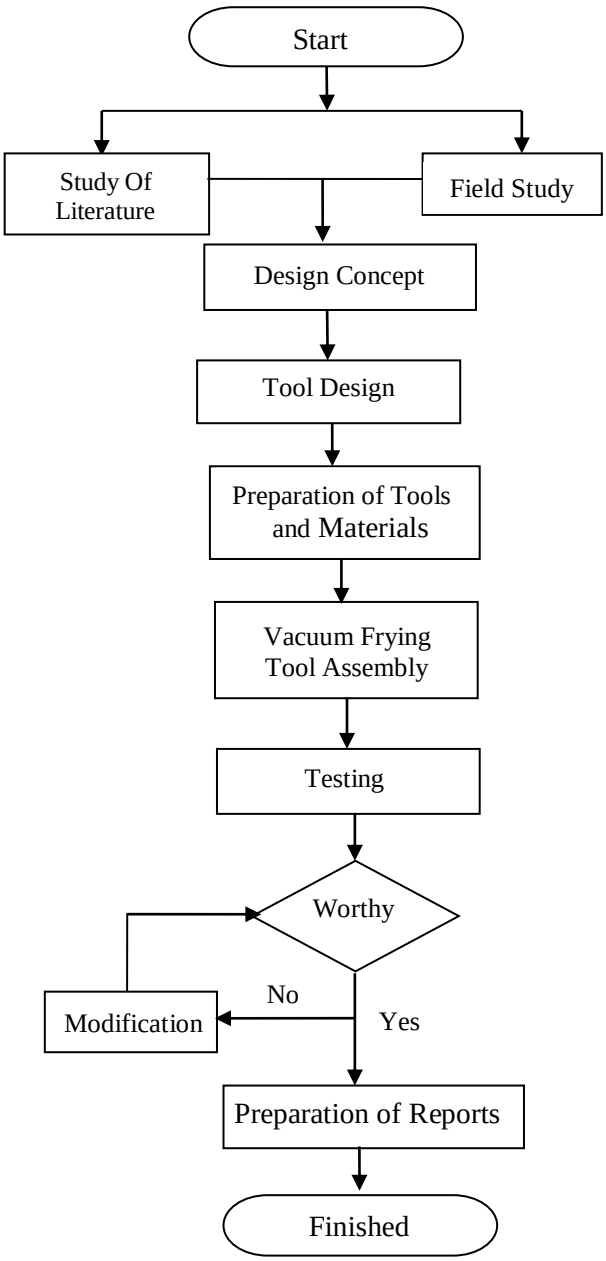

Figure 1. Design flow chart of vacuum frying

Results and Discussion

Design of Vacuum Frying

In Figure 2 is a chip frying machine with a whole vacuum frying system where this machine has several main components. For more details can be seen in Figure 3.

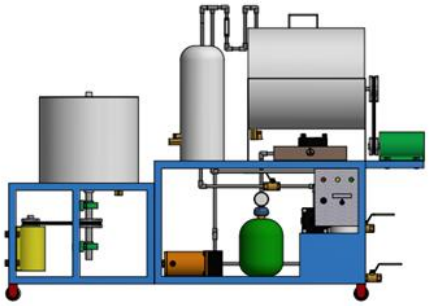

Figure 2. The overall design of the vacuum fying.

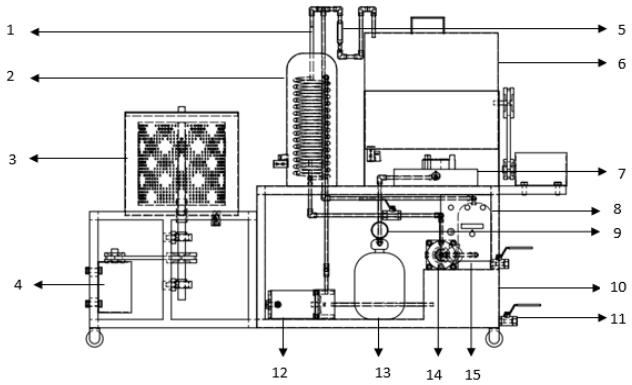

Figure 3. Vacuum frying device schematic

Information **Figure 3**:

1. Pipe
2. Condenser
3. Spinner
4. Electric Motor
5. Flow meter
6. Frying tube
7. Gas stove
8. Control panel
9. Pressure Gauge
10. Water reservoir
11. Valve
12. Water pump
13. Gas cylinder
14. Vacuum pump
15. Water trap

Fryer Tube Volume Calculation

In calculating the volume of the frying tube, it is very necessary to do this because we can find out how many liters of oil are needed in the frying process later.

Calculating the Total Volume of Frying Tubes

$V = \pi . r^2 . t$

V = 3,14 x (10,75 cm)^2 x 32 cm

V = 11.702,44 cm^3 x $\left| \frac{1\ Liter}{1000\ cm3} \right|$

V = 11,7024 L

Calculating Frying Tube Capacity

Tube Capacity = 75% x Total Volume

= 75% x 11,7024 L

= 8,7768 L

Total Volume of Vacuum Frying

V = p .l.t

= (100 cm x 40 cmx 65 cm)

= 260000 cm^3

Electric Motor Power

P = F. r.2.η.n

P = 19, 6 x 400x10^{-2} x 2 x 3,14 x 5 Rpm

P = 2461,76 watt = 3,3012 HP

The prototype design of the Vacuum Frying type fryer has an overall volume of 260,000 cm^3 with an overall length of 100 cm, width 40 cm and height 65 cm and uses an electric motor power of 2461.76 watts or 3.3012 HP. Prototype design of Vacuum Frying fryer for frying oyster mushrooms into oyster mushroom chips products in accordance with SNI with better product quality than conventional fryers.

Vacuum frying tool is a frying tool for various products, not only for frying oyster

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mushrooms but also fruits and vegetables such as salak, pineapple, papaya and so on with vacuum conditions. The benefit of vacuum frying is that it can reduce the water content of the product but still maintain the natural color, aroma and taste of the product.[8]

This vacuum frying tool is equipped with various components that have various uses in supporting the success of the tool. Such as frying pans, spinners, condensers, and so on. The frying tube has a length of 29.8 cm, with a tube diameter of 21.5 cm. On the inside of the frying tube there is a frying basket as a place to fry oyster mushrooms. The size of the frying basket is 22 cm long, 15 cm wide and 7 cm high. This frying basket has a capacity of 500 grams of oyster mushroom frying. This frying basket has a capacity of 500 grams of frying oyster mushrooms. The prototype design of this Vacuum Frying type fryer has a total volume of 11.7024 Liters of frying tube with a frying tube capacity of 75% of the total volume of frying tubes, so the capacity of this frying tube is 8.7768 L. This frying tube uses stainless steel material with a thickness of 0.48 cm. The reason for using this stainless steel material is because it is more hygienic and easy to care for and clean, besides that this material is not easily corroded so it is safe to use for frying food. There is a stirrer lever to rotate the frying basket so that the mushrooms that are being fried can be stirred and do not burn or partially cook. The stirrer motor is driven with the help of an AC 220 Volt type electric motor with a speed of 5 Rpm. This stirrer motor can be set on the panel box or control panel.

There is also a condenser that condenses or converts a high pressure gas or vapor into a liquid with the help of a vacuum pump, which creates a vacuum by removing air from a closed system by sucking air in the frying tube periodically. The condenser plays an important role in producing low-moisture chip products because the condenser sucks the water content in the ingredients during frying in a frying tube. In addition, the vacuum in the frying tube and the power of the vacuum pump also affect the performance of the condenser. The more vacuum the frying tube, the lower the moisture content of the resulting chips, as a result the chips have a long shelf life, are crispy and not easily rancid. Lose water content faster at high temperatures and the shelf life of the product will be longer if the content less water.[10] The effect that occurs can be seen from the appearance, acceptability, and shelf life of the food product.[11] The condenser on the prototype of the Vacuum Frying fryer has a height of 38.5 cm with a diameter of 10 cm.

There is also a water reservoir equipped with a water pump for circulating water from the condenser. This water reservoir has a length of 40 cm, a width of 24 cm and a height of 16.5 cm. The water pump used is a RECENT AA 103 type water pump with 220 watts.

The water vapor that changes phase to water from the condenser is flowed into the water trap tube as a condensate reservoir. This water trap has a height of 30.5 cm and a tube diameter of 7 cm. This vacuum frying tool is also equipped with a flowmeter with a range of 0.1–1 LPM and a panel box to control various measuring instruments such as temperature, stirrer motor, vacuum pump, air flow rate and pressure.

This vacuum frying tool uses a heating source, namely fire from a gas stove with LPG (Liquefied Petroleum Gas) fuel, and electricity to power several components on the panel box. With frying media, namely cooking oil. Vacuuming in the frying process must use a special pump so that the vacuum process that occurs in the tool will be more optimal.

There is a pressure gauge which is used to measure the pressure in the frying room. The pressure gauge used is the RVG 005 bottom type with a diameter of 2.5 in made of iron. Control panel which aims to set-up the temperature that will be used for frying. Condenser which aims to condense the water vapor contained in the frying room. The vacuum pump is connected to the jet injector component which functions to suck the air in

the frying room, so that the frying room becomes a vacuum.[12]

The design of this vacuum frying tool is made to produce a higher quality product and lower water content so that the resulting oyster mushroom chip product has a longer shelf life, is crispier and does not go rancid easily. Before frying, the oyster mushrooms are frozen first at -2 so that the resulting chips are more crispy.[15]

Tabel 2. Data Analysis of Moisture Content Before Frying

No.	Name	Oven Temperature Used	Water Content
1	Oyster Mushroom	100	2,46
2		100	2,45
3		100	2,42
4		100	2,41
5		100	2,41

Tabel 3. Data Analysis of Moisture Content After Frying

No.	Name	Oven Temperature Used	Water Content
1	Oyster Mushroom	100	0,77
2		100	0,69
3		100	0,59
4		100	0,53
5		100	0,54

The key to the success of the vacuum fryer is in the vacuum of the frying tube. The frying tube is expected to be very tight so that no air enters and leaves the frying tube except for water vapor that comes out through the pipe to the condenser. If the frying tube has air inlet and outlet gaps, it will be difficult to achieve vacuum frying conditions, this can affect the quality of the oyster mushroom chips product, especially the water content of the product which affects the shelf life and crispness of the chips. The advantages of this vacuum fryer are that we can adjust the required temperature and the temperature stability is more guaranteed[12] and the level of maturity can be adjusted and the frying time is shorter.[14]

The results of frying oyster mushroom chips using a prototype vacuum fryer produce chips whose water content is very low, namely below 1% with 80% water content evaporated. This value indicates that the prototype of this vacuum fryer succeeded in producing oyster mushroom chips with good product quality.

Conclusion

The prototype of vacuum frying fryer is designed to produce oyster mushroom chips which are low in water content, crunchy and have a long shelf life. The results of the prototype design of this vacuum frying fryer have an overall volume of 260,000 cm3, with a total volume of 8.7768 L of frying tubes and a volume of 500 grams of mushroom frying basket and an electric motor power of 2461.76 watts or 3.3012 HP.

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