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RESEARCH ARTICLE

DESIGN OF LPG GAS OVEN TECHNOLOGY AS AN EFFORT TO INCREASE SALTED FISH PRODUCTION IN SUMEDANG, INDONESIA

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Abstract

Processing salted fish is one of the traditional ways of preserving fish carried out by the community when the fish harvest is abundant. However, traditional processing of salted fish is not always hygienic and can cause health problems if not done properly. In this context, Liquefied petroleum gas (LPG) gas ovens are a technology that can help increase the productivity of hygienic processing of salted fish. LPG gas oven is a drying oven that uses gas energy to dry fish. By using an LPG gas oven, drying fish can be done quickly and hygienically, thereby reducing fish spoilage and damage. This research succeeded in designing and assembling an LPG gas oven and providing technical training to the community in its use. This will help increase people's knowledge and skills in using LPG gas ovens to dry and make salted fish hygienically. Using LPG gas ovens as a salted fish processing technology can be the best solution to overcome excess catches that have not been sold on the market and produce more hygienic salted fish production. Thus, LPG gas ovens can help increase the productivity and welfare of the community around the Jatigede Dam, Sumedang Regency, who depend on the fish catch from Lake Jatigede as their source of livelihood. Another advantage of processing salted fish using an LPG gas oven is that it overcomes the weakness of traditional drying, namely when it rains suddenly, causing the humidity in the fish to increase; produces salted fish that is more hygienic, free from dust, and free from flies landing which will produce eggs, which is the cause of salted fish worming and becoming rotten and wasted and overcoming the storage process, where some traders actually store it in the refrigerator, which is limited in nature and in ultimately affects changes in the aroma and taste of the product after being processed/re-dried.

Introduction:-

Along with the development of science and technology, as well as improving people's quality of life, technology is also being used to overcome the problems faced in everyday life. One of them is in the economic sector, with efforts

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to increase financial benefits and income for society. This basis then becomes the reason for implementing community service by utilizing simple technology to help realize increased processing productivity, such as increasing the productivity of salted fish processing. Salted fish is a type of side dish that has been in great demand by Indonesian people from time immemorial until now (Sabilah et al. 2022). Processing fish into salted fish is one way to preserve fish which has been done for a long time using traditional methods. This is done by the community to minimize losses resulting when the fish harvest is very abundant. Drying salted fish is one way to preserve fresh fish that has been treated with salt, thereby reducing the activity of microorganisms, so that the shelf life of salted fish is longer.This method has of course been used for a long time by salted fish business people for various fish species (Rani et al. 2022). Traditional drying of salted fish using the salting method has been carried out for generations and can be found among the community, one of which is the community around Lake Jatigede, Jatigede District, Sumedang Regency, West Java Province, Indonesia. Reporting from the Sumedang Regency Fisheries and Livestock Service (Disanak), currently the community around Lake Jatigede is exploring fish salting as a business development in the freshwater fisheries sector. Currently, the salted fish production of the community around Lake Jatigede is around 50 kg of fresh fish per day, where the number of salted fish craftsmen who are members of the Dahlia processing and marketing group (Poklahsar) reaches 10 people. Even though production is not carried out every day, the demand for salted fish around Sumedang Regency continues to be stable and tends to increase (DISKOMINFO 2021).

According to the Sumedang Regency government, the salted fish business developing around Lake Jatigede, Jatigede District, Sumedang Regency, West Java Province, Indonesia provides added value and benefits for the surrounding community. This means that the salted fish business can provide profits for the salted fish business owner. The same thing was expressed by Geffken et al. (2016), where the salted fish business can provide profits for business actors of IDR 9,895,083 from a total investment of IDR 76,952,000. The development of the salted fish business has the potential to achieve prosperity for the community because it can have a positive impact on all parties, including: 1) for salted fish traders, if sales increase, there will be an increase in income, 2) for fishermen who do not double as salted fish traders, it will also gain profits because fish that are not selling well in the market are still bought by salted fish traders. Certain types of fish are excluded from the fish sold in the market, and 3) for the community there will be food diversity available (Geffken et al. 2016).

The application of drying technology such as an oven fueled by liquefied petroleum gas (LPG) is a drying device designed to absorb and utilize gas energy, so that the resulting effect is like a greenhouse effect which can store heat despite changes in weather and climate. This oven has a projector which functions to distribute heat evenly inside it, and has a fan which functions to regulate the temperature (Benjamin et al. 2022). LPG-fueled ovens are a technology used to carry out community service for fishing communities who also act as salted fish entrepreneurs around Lake Jatigede, Jatigede District, Sumedang Regency, West Java Province, Indonesia.

Materials and Methods:-

The research was conducted from May 2023 to November 2023 at the location of the salted fish drying business, namely Cipondoh Village, Paauthor Village, Wado District, Sumedang Regency, West Java, Indonesia. Supporting equipment needed to make a gas-drying oven includes a hacksaw, aluminium cutting machine, electric drill, concrete drill bit, electric drill bit, screwdriver, cutter, pliers, rivets, measuring tape, 45-angle tool, scraper and sandpaper.

The method used in this research is to design the frame test the machine and then analyze the machine to ensure the machine can work well. A gas-drying oven is a device that uses gas energy to produce the heat needed to cook or bake food. Box-shaped gas drying oven. In the context of salted fish production, a gas-drying oven can be used to speed up the fish-drying process. Salted fish is usually dried in the open sun, so it takes a long time and is vulnerable to rain or bad weather. By using a gas-drying oven, salted fish can be dried more quickly and with more control, because the oven temperature can be regulated and made constant and the drying time can also be determined.

The way to use a gas-drying oven in the production of salted fish is to place the salted fish on a rack placed in the oven. The heat produced from the gas will be distributed evenly into the oven and produce heat that will dry the salted fish. In this case, the gas drying oven can be operated with 3 kg LPG gas so it does not require an electrical power source from the power grid or sunlight.

The use of a gas drying oven can increase productivity in salted fish production because it can produce salted fish that is faster and drier, with a shorter and more controlled drying time. Apart from that, using a gas-drying oven can also reduce production costs, because it does not require expensive fuel or electricity from the electricity network.

The steps for making a gas-drying oven are as follows: (1) Preparation of materials and equipment to be used; (2) Cutting materials based on predetermined sizes; (3) Make the oven frame according to plan; (4) Install the dryer frame, starting with assembling the legs and rack I, then rack II and so on until rack IV. Before rack II is combined with rack I, first insert acrylic plastic on the left, right and back, except the front which includes the door; (5) Assemble the cover of the dryer; and (6) Test the tool by drying the fish.

Theory

Fish

The source of protein that comes from animal sources and is widely known by the Indonesian people is fish. However, fish is known as a food that is very easily damaged because it contains very high levels of water and triggers the growth of microorganisms (Hatta et al. 2019).It is known that fish that is good for consumption certainly has a neutral pH, soft texture and very high nutritional content (Tenyang et al. 2020). The high content of protein, vitamin A and vitamin D is also a special attraction for fish. Fish protein, which is around 18–30%, consists of essential amino acids that are easily digested (Ciptawati et al. 2021). Besides protein, fish also contain other components such as unsaturated fats, vitamins, minerals and other easily digestible connective tissue(Bau et al. 2021). The composition of protein and fat in fish is generally inversely proportional, where fish with low-fat content have high protein levels, and vice versa, fatty fish have low protein levels(Taniyo et al. 2021).

However, it is known that fish has a relatively high-fat content, and the types of fatty acids found in fish are more abundant than in land animals, so it can have an impact on increasing fat levels in the human body which causes exposure to cholesterol (Mardiono Jacoeb et al. 2020). Saturated fatty acids in fish are in carbon chains with a length of C14 – C22 and unsaturated fatty acids in fish are in carbon chains with a length of C1 – C6. Meanwhile, land animals only contain less saturated and unsaturated fatty acids than fish. These unsaturated fatty acids make fish more easily contaminated by microorganisms which cause fish to rot easily. Therefore, rancid odours often occur in fish commodities, especially in processed products and preservatives that are stored without packaging and antioxidants. It also contains carbohydrates, vitamins, and minerals (Ndahawali et al. 2018). Apart from protein and fat, fish also contain carbohydrates which are glycogen-type polysaccharides similar to carbohydrates in starch. However, the carbohydrate content in fish meat is only around 1%. As for other components such as vitamins, fish certainly contains vitamins that are easily soluble in water and fat. Vitamins B, B2, B6, B12, folic acid, cyanocobalamin, carnitine, biotin, niacin, inositol and pantothenic acid are vitamins found in fish easily soluble in water. Meanwhile, vitamin C is only slightly soluble in water. Vitamins A, D, and E are types of vitamins found in fish that are easily soluble in fat (Mardiono Jacoeb et al. 2020).These vitamins are generally found more in the internal organs of fish than in the flesh of land animals. Adding salt to salted fish certainly enriches the vitamin and mineral content such as phosphate salts, calcium, sodium, magnesium, sulfur and chlorine in salted fish.

Drying fish

Drying fish is a method used since ancient times to preserve fish. Drying can suppress or reduce the activity of microorganisms in fish (Bau et al. 2021;Aniesrani Delfiya et al. 2022). This technique is one way that aims to extend the shelf life of fish and has been used for a long time on various types of fish (Ramos et al. 2021). Generally, drying is done under sunlight for ± three days in sunny weather conditions, while turning the fish so that it dries evenly (Bau et al. 2021;Di Giorgio et al. 2022). However, there are problems or shortcomings in its application, where the dried fish suffers from poor quality conditions, such as the fish's cleanliness free from dust, dirt, foreign objects and microorganisms (Hamdani et al. 2018;Cui et al. 2021).

Drying fish using salting techniques is one way to increase people's consumption of fish(Azizah et al. 2022).However, currently, the processing of dried salted fish carried out by the community is still traditional, especially about the conditions of the drying process (Hamdani et al. 2018;Azizah et al. 2022). Therefore, modification of drying conditions is necessary, considering the increasing public demand for salted fish(Rani et al. 2022).

Salted fish

Salted fish is an important food ingredient in Indonesia and other tropical countries. Salted fish production still relies on the traditional method of drying in the open sun. However, this drying method takes a long time and requires a lot of labour. Therefore, technological innovation is needed in the salted fish drying process to increase efficiency and productivity. One method used by fishermen is to dry the fish naturally by drying it directly under the hot sun and then the next process will be carried out. However, sometimes the natural drying process has many disadvantages, including long drying times, requiring a large location, the quality of the fish, and fly interference, especially during the rainy season, which will hamper the drying process(Sabilah et al. 2022;Rani et al. 2022;Antia et al. 2021).

Drying oven fueled by liquefied petroleum gas

State-of-the-art drying with liquefied petroleum gas (LPG) energy has become an alternative for drying agricultural products. A gas drying oven is a source of heat energy, and an air circulation system to remove moisture. Gas drying ovens can also be equipped with temperature and humidity sensors to control the drying process.

Research on drying with gas energy has been carried out by many researchers. Using gas energy can increase drying efficiency and productivity. The use of LPG gas oven technology has had a positive impact on various industrial fields, both on the micro and macro scale. Easy to use, with lower production costs (Rinda et al. 2021;Setyawan et al. 2018;Benjamin et al. 2022), and can be used for various materials to be dried, making it an alternative that can be developed.

A roadmap based on the literature review that has been carried out, research on LPG Gas Oven Design Technology as an effort to increase salted fish production in Sumedang will develop gas drying oven technology using gas as an energy source. Gas was chosen because it can produce heat directly, thereby saving operational costs.

The gas drying oven being developed will be equipped with temperature and humidity sensors to control the drying process. Additionally, the gas drying oven will be equipped with an adequate air circulation system to remove moisture effectively. In developing a gas-drying oven, trials will be carried out using various types of salted fish that are commonly sold on the market, such as freshwater fish. In developing a gas drying oven, 3 kg LPG gas will be used. Conclusion: To increase the efficiency and productivity of drying salted fish, it is necessary to develop a gas drying oven using LPG gas as an energy source.

Based on this description, it is known that this LPG-fueled oven technology can be transferred to communities in various fields (agriculture, plantations and fisheries) to reduce post-harvest losses and increase their economic income, especially to communities in the salted fish drying business.

Salted fish in Lake Jatigede Village, Jatigede District, Sumedang Regency, West Java Province, Indonesia

Based on preliminary observations of salted fish entrepreneurs around Lake Jatigede, Jatigede District, Sumedang Regency, West Java Province, Indonesia, it is known that there is a decline in salted fish production during the rainy season, salted fish fails to dry completely, causing the appearance of maggots and rot. fish. This also affects the buying and selling process. In general, people are more interested in the appearance of salted fish that is good, clean, hygienic and of course has a delicious taste. As a result, the decline in salted fish stocks during the rainy season causes high selling prices and people's purchasing power decreases. Apart from that, this technology can also be used to deal with abundant fish harvests, which can then be processed into hygienic salted fish in large quantities (capacity up to 15 kg). Not only that, the two partner groups are known to process salted fish daily using the method of salting and drying directly under the sun. This research provides a solution by utilizing technology in the form of an LPG gas oven to increase hygienic salted fish production in coastal areas so that it has an impact on increasing financial profits and income for salted fish entrepreneurs.

Results:-

Detailed engineering design of salted fish drying oven with liquefied petroleum gas fuel

The salted fish drying oven is designed to use an LPG-fueled furnace as a source of hot air or gas. There are two burners at the bottom of the oven, namely the left and right sides, then the gas or hot air produced automatically fills the cavity or distribution space for the hot air or gas which is found on the left, right, middle and back sides of the oven. There is a hole on the inside of the cavity or distribution space for hot air or gas which is located between the shelves where the material is dried. At the top of the oven, there is an outlet for hot air or gas which comes from the drying room and also functions as a heat regulator in the drying room. Table 1 shows the dimensions of the

components in the salted fish drying oven. Fig.1 and 2show the detailed engineering design (DED) of an LPG fuel oven. Fig. 3 shows the shape of a salted fish drying oven that has been made and applied for drying salted fish, and Table 2shows a list of materials for salted drying equipment.

Table 1:- Dimensions of the components in the salted fish drying oven.

No.	Oven components	Dimensions
1	Oven dimensions (length x width x height)	1800 x 1000 x 2000 mm
2	Total dimensions of drying chamber (length x width x height)	1650 x 925 x 1750 mm
3	Dimensions of 1/2 drying chamber (length x width x height)	825 x 925 x 1750 mm
4	Distance between material shelves (there are 2 x 10 shelves in the drying room)	145 mm
5	The distance between the bottom shelf and the bottom oven wall	188.5 mm
6	Distance of upper rack to upper oven wall	126.5 mm
7	Thickness of the frame or distribution space for hot air or gas (left, right, middle and rear)	50 mm
8	The thickness of the frame or distribution space for hot air or gas (top side)	100 mm
9	Dimensions of the inflow of air or hot gas originating from the furnace (diameter on the left and right sides)	200 dan 200 mm
10	Dimensions of the outflow of hot air or gas originating from the drying chamber (length x width located in the centre of the oven)	200 x 200 mm
11	Dimensions of the hole on the inside of the cavity or hot gas or air distribution chamber (length x width)	200 x 10 mm
12	Distance between hot air or gas distribution holes (there are 10 holes on each wall in the oven)	145 mm
13	Oven door (length x width x height)	890 x 16 x 1847
14	Height of oven legs	200 mm

Table 2:- List of bill of materials (BOM).

No	Materials
1	Hollow 50 x 50 Galvanis
2	Hollow 15 x 30 Galvanis
3	Hollow 20 x 20 Galvanis
4	Plate 1 mm x 1200 mm x 1400 mm Galvanis
5	Wire Mesh ¼” x 0,5 Galvanis
6	Siku 40 x 40 SS 400 Besi
7	Siku 30 x 30 SS 400 Besi
8	Plate Strip 2 x 30 SS 400 Beso
9	Siku 1” x 0,7 mm Alumunium
10	Siku 5/8” x 0,7 mm Alumunium
11	Plate Strip ¾” x 0,7 mm Alumunium
12	Paku Ripet Ø 3,2 mm
13	Skrup Crouping 40 mm
14	Engsel Kupu-kupu
15	Tungku Burner Rinnai High Pressure

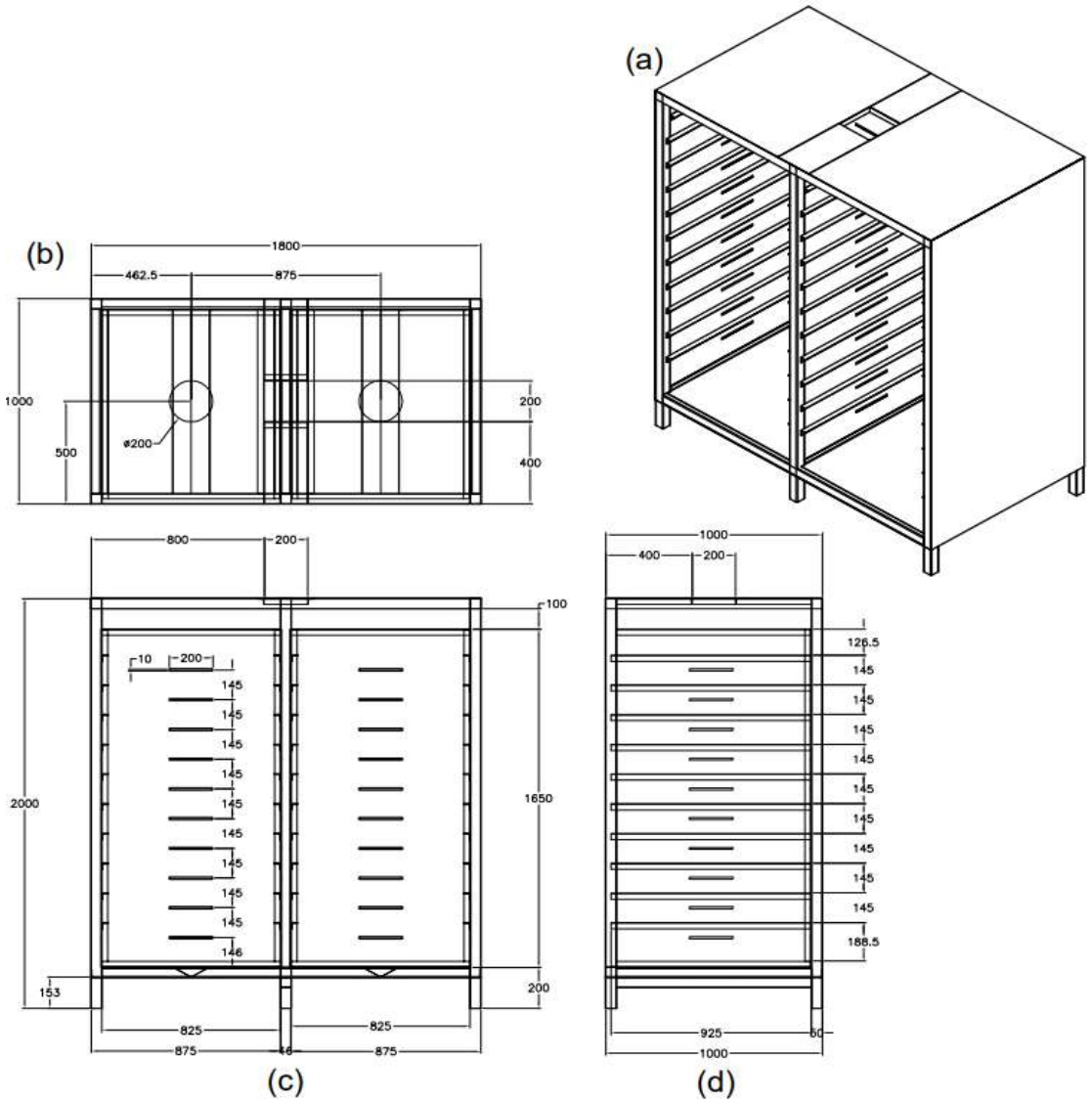

Fig. 1:-DED oven with LPG fuel. (a) Three-dimensional view; (b) Top view; (c) Front view; and (d) Side view.

Oven trial in drying salted fish

A salted fish drying oven with a capacity of 50 kg per batch has been designed to become a single oven ready for use and then tested directly on drying salted fish. Table 3 shows the results of oven trials at three operating temperature conditions on the water content of salted fish.

Table 3:- Results of oven trials at three operating temperature conditions on water content of salted fish.

.No.	Treatment temperature (^{o}C)	Time (minutes)	Weight of fresh fish after adding salt (g)	Water content (%)				Amount of water evaporated (%)
				Beginning	Bottom shelf	Middle shelf	Top shelf	
1	40	300	1.73	94.20	86.00	86.70	87.20	7.57
2	70	180	1.73	94.20	67.80	69.20	70.80	31.45
3	80	120	1.73	94.20	38.70	50.80	52.70	68.79

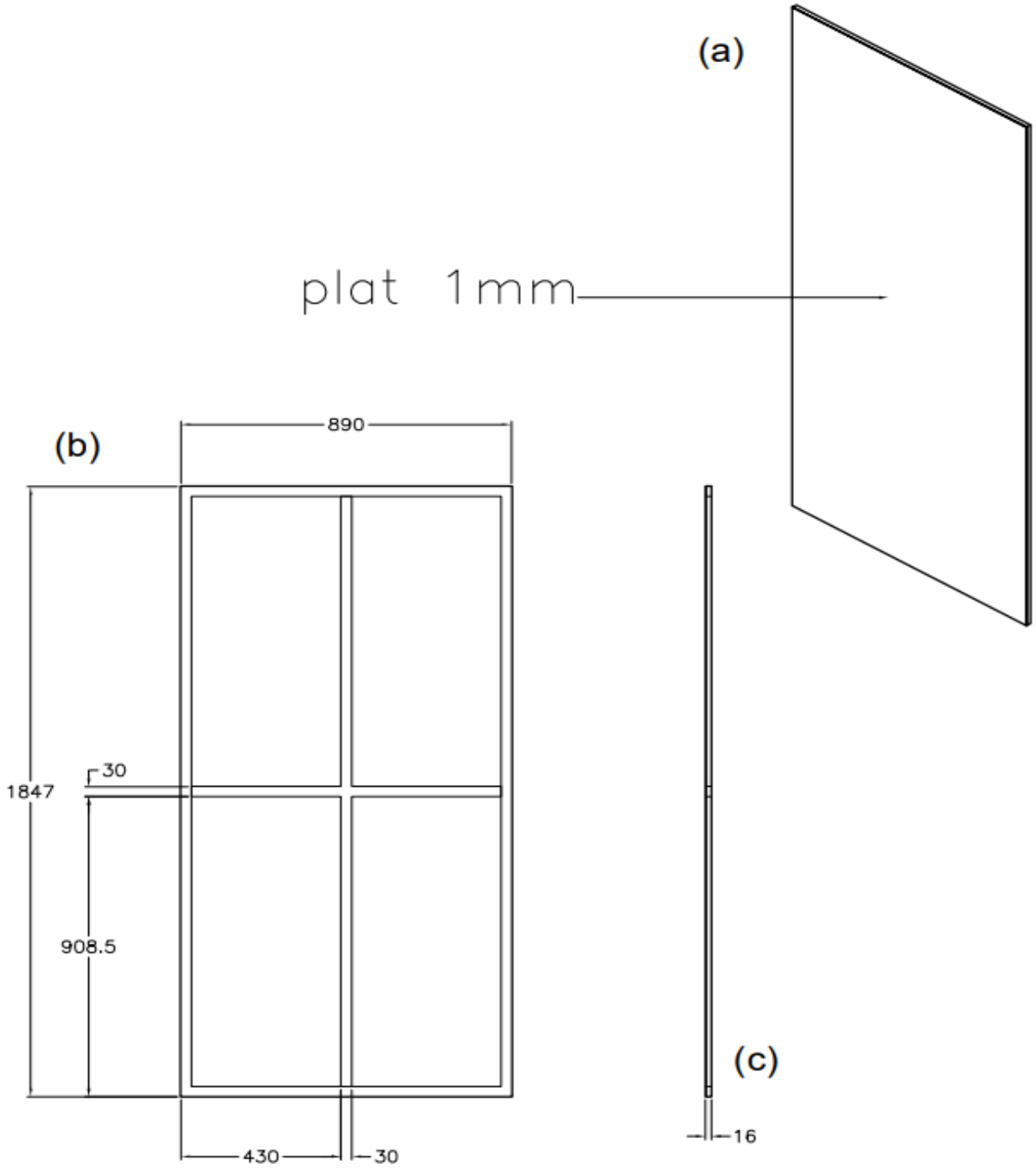

Fig. 2:- DED of LPG fuel oven door. (a) Plate; (b) Front view of the oven door; and (c) Side view of the door and plate (thickness).

Fig. 3:-Designed salted fish drying oven.

Discussion:-

Detailed engineering design of salted fish drying oven with liquefied petroleum gas fuel

In achieving sustainability in the salted fish production business, the role of technology is considered important to implement. One of them is the technology used in drying fresh fish after adding salt to become dried salted fish. The drying technique used will certainly affect the quality of the salted fish produced (Al-Rubai et al. 2020;Rani et al. 2022;Delima et al. 2022). Drying in a short time is certainly a hope for salted fish production businesses. The conventional drying process is generally carried out by drying fresh fish that has been salted under direct sunlight, but this process certainly takes a relatively long time due to its dependence on the weather (Sabilah et al. 2022). Several salted fish drying technologies have recently been developed in Indonesia, one of which is drying using an oven (Al-Rubai et al. 2020;Rinda et al. 2021). Drying techniques using a dryer will be more efficient and reduce pollution and the danger of poisoning in salted fish products (Al-Rubai et al. 2020). Therefore, in this research, we tried to design a salted fish drying device as an LPG fuel oven.

The oven that is made is basically the same as a household oven, where the drying medium is hot air or combustion gas that comes from the furnace. In general, batch or semi-batch operations can be implemented. In all cases, design efforts for this type of oven focus on determining the appropriate equipment configuration: namely the cavity or distribution space for hot air or gas originating from the combustion of the furnace, plate thickness, distribution rate of air or hot gas originating from the combustion of the furnace, holes heat originating from the cavity or air space or hot gas goes to the drying room, as well as the number of trays in the drying room.

Other specifications of the oven being developed that can provide benefits for the salted fish business group are as follows: (1) The material used is anti-rust aluminium of good quality, so that when exposed to rain and heat it can still last a long time, and is suitable for areas around lakes; (2) The maximum hot temperature is maintained up to 75-80 degrees; (3) This oven can also be disassembled, making it easier to move it to another location without

damage; and (4) Larger loading capacity so that it can accommodate around 50 kg of fish to be dried so that it can increase the amount of production from the usual amount.

There are several drawbacks to the design of a tray or rack system oven where the heat source comes from the stove placed under the oven. The biggest disadvantage is uneven drying due to uneven distribution of air flow or hot gas in the drying chamber, resulting in non-uniformity of drying and reduced dryer efficiency (Kiranoudis et al. 1997;Misha et al. 2013). Therefore, it is necessary to test the oven that has been designed to ensure that the components in the oven can function properly, especially regarding the cavity or space where hot air or gas is distributed from the furnace to the drying room.

Oven trial in drying salted fish

The process of drying salted fish with a designed oven can be carried out in batch mode or semi-continuous mode. In batch mode, fresh salted fish is added after the dried salted fish from the previous batch is removed. In semi-continuous mode, the partially dried salted fish is transferred to another tray and the empty tray is filled with fresh, salted fish. Fresh fish that has been salted with high water content is placed in the upper tray, while partially dried salted fish is transferred to the lower tray. Otherwise, the moisture from the fresh salted fish will be carried by the hot air to the partially dried salted fish, potentially increasing the humidity again. This is similar to what was expressed by(Misha et al. 2013). Additionally, Misha et al. (2013)said that the manual tray movement system in the drying chamber was designed to overcome the obstacles of uneven distribution of hot air or gas, as encountered in most stationary tray drying systems. Using a manual tray movement system in the drying room helps increase the drying rate and produces a uniform quality of dried salted fish. However, the oven trials that had been designed were carried out using a batch system on fresh fish that had been treated with salt. The hope is that from the test results information will be obtained on the drying rate of salted fish placed on the bottom, middle and top shelves. The trial was carried out without involving a manual tray movement system.

A salted fish drying oven with a capacity of 50 kg per batch has been designed to become a single oven ready for use and then tested directly on drying salted fish. Fresh fish that has been salted is then placed in the oven on the bottom, middle and top shelf positions. Next, at the bottom of the oven, hot air or gas flows from the high-pressure LPG gas combustion furnace (the pressure of the gas that comes out is the same as the pressure in the gas cylinder). The level of large or small flame is regulated at three levels, namely small, medium and large flame. The fire that is formed will channel heat into the cavity or distribution space for hot air or gas to the drying room. The air or gas flow is stopped when the temperature in the drying chamber has reached 60, 70, and 80 oC. After the temperature at the top of the drying room reaches the treatment temperature, the temperature distribution in the drying room at the top, middle and bottom is measured using a thermometer. Next, the oven is left in a closed condition until the temperature inside the drying room returns to being as stable as the temperature outside or around the oven (reaches room temperature) or left for approximately 90 minutes. After that, the salted fish is removed from the drying room and then the water content of the salted fish is measured. The identification process was carried out three times.

The water content of salted fish is analyzed by looking at the amount of water contained in the salted fish, both before drying and after drying. The difference between the two is the amount of water that was successfully evaporated during the drying process. This is of course the same as the drying principle in general(Mujumdar dan Devahastin 2008;Antia et al. 2021;Shirkole et al. 2023). Water content was estimated using equation (1) adopted from (Antia et al. 2021).

$$\text{MoistureContent(MC)} = \frac{\text{InitialMass (IM)} - \text{FinalMass (FM)}}{\text{FinalMass (FM)}} \text{x } 100\% \quad (1)$$

Meanwhile, the amount of water that evaporates based on the total weight of fresh fish that has been salted is estimated using equation (2) adopted from(Antia et al. 2021).

$$\text{WaterVapor(WP)} = \frac{\text{InitialMass (IM)} - \text{FinalMass (FM)}}{\text{InitialMass (IM)}} \text{x } 100\% \quad (2)$$

In general, the water content of various freshwater fish in Lake Situgede, Jatigede District, Sumedang Regency, West Java Province, Indonesia is around 67.50% to 77.75%(Herawati et al. 2018). Table 3 shows the results of oven trials at three operating temperature conditions on the water content of salted fish. The results of identifying the water content of dried salted fish showed that drying at a temperature of 40 oC for 300 minutes produced dried salted fish with a water content of 38.7% (drying at the bottom), while drying at the same conditions produced dried salted fish whose water content was still low. is above 40% or above the maximum quality standard for dried salted

fish water content set by the National Standardization Agency (BSN) as stated in the Indonesian National Standard (SNI) number 8273 of 2016 (SNI 8273-2016)(BSN 2016). The same thing happened to the results of drying salted fish with temperature conditions and drying time of 70 oC for 180 minutes and 80 oC for 120 minutes. This means that the suitability of temperature and drying time greatly influences the water content of dried salted fish. Several previous research results also revealed the same thing for rack-type drying equipment (ovens) (Benjamin et al. 2022;Rinda et al. 2021;Al-Rubai et al. 2020;Misha et al. 2013). In the test results with drying conditions of 40 oC for 300 minutes, 68.79% of the water in fresh fish that had been given salt was successful in evaporating the total weight of the initial fresh fish, which means that fresh fish that had been given salt experienced a weight loss of 68.79%. % after drying of the total initial weight.

The oven which has been designed as a tool for drying salted fish makes a positive and effective contribution in reducing the water content of salted fish as seen from the percentage decrease in water content during drying and the percentage of water content in salted fish that has been dried. However, you need to know that the different methods of drying and salting fish provide a wide scope for preserving fish for a long period of time. The correct method for drying salted fish certainly has an impact on the level of efficiency in drying and preserving. Dried salted fish is expected to provide a low percentage of chemical and microbial indices, and the shelf life of dried salted fish will be longer compared to dried salted fish produced from conventional drying (using sunlight). This is similar to what was stated by Al-Rubai et al. (2020)and Rani et al. (2022). Optimizing the conditions of the drying process certainly needs to be achieved so that the level of efficiency in the use of energy and resources during drying reaches the highest level of efficiency or the use of energy and resources is as minimal as possible.

Conclusion:-

Using LPG gas ovens as a salted fish processing technology can be the best solution to overcome excess catches that have not been sold on the market and produce more hygienic salted fish production. Thus, LPG gas ovens can help increase the productivity and welfare of the community around the Jatigede Dam, Sumedang Regency, who depend on the fish catch from Lake Jatigede as their source of livelihood. Another advantage of processing salted fish using an LPG gas oven is that it overcomes the weakness of traditional drying, namely when it rains suddenly, causing the humidity in the fish to increase; produces salted fish that is more hygienic, free from dust, and free from flies landing which will produce eggs, which is the cause of salted fish worming and becoming rotten and wasted and overcoming the storage process, where some traders actually store it in the refrigerator, which is limited in nature and in ultimately affects changes in the aroma and taste of the product after being processed/re-dried.

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References:-

1. Al-Rubai, H.H., Hassan, K.H.A., Eskandder, M.Z., 2020. Drying and salting fish using different methods and their effect on the sensory, chemical and microbial indices. Multidiscip. Rev. 3(1), 1–7.https://doi.org/10.29327/multi.2020003.
2. Aniesrani Delfiya, D.S., Sneha, R., Prashob, K., Murali, S., Alfiya, P.V., Samuel, M.P., 2022. Hot air-assisted continuous infrared dryer for anchovy fish drying. J. Food Process Eng. 45(6), e13824.https://doi.org/10.1111/jfpe.13824.
3. Antia, O.O., Olosunde, W.A., Antia, E.O., 2021. Application of basic drying theory to determine drying mass constants of selected seafoods. Glob. J. Eng. Technol. Adv. 7(1), 137–143.https://doi.org/10.30574/gjeta.2021.7.1.0062.
4. Azizah, N., Asfiyanti, N.A., Hasibuan, M., Jannah, M., Gustari, R., Hasibuan, R.S., 2022. The effect of fish thickness on dryness level and time for drying fish. Int. J. Nat. Sci. Eng. 5(3), 114–119.https://doi.org/10.23887/ijnse.v5i3.41891.

5. Bau, F.C., Nina, S.U., Antuli, Z., 2021. Pengaruh lama pengeringan terhadap kualitas kimia dan biologis ikan teri asin kering (Stolephorus sp.). Jambura J. Food Technol. 3(2), 94–101.https://doi.org/10.37905/jjft.v3i2.9101.
6. Benjamin, E., Stephen, A.A., Onyewuchi, E., Uchenna, N., 2022. Design and analysis of energy and exergy performance of an LPG-powered fish drying machine. J. Kejuruter. 34(1), 117–129.https://doi.org/10.17576/jkukm-2022-34(1)-11.
7. BSN., 2016. SNI 8273-2016 Tentang Ikan Asin Kering. Jakarta.
8. Ciptawati, E., Rachman, I., Rusdi, H., Alvionita, M., 2021. Analisis perbandingan proses pengolahan ikan lele terhadap kadar nutrisinya. Indones. J. Chem. Anal. 4(1), 40–46.https://doi.org/10.20885/ijca.vol4.iss1.art5.
9. Cui, T., Chen, C., Jia, A., Li, D., Shi,Y., Zhang, M., Bai, X., Liu, X., Liu, C., 2021. Characterization and human microfold cell assay of fish oil microcapsules: Effect of spray drying and freeze-drying using konjac glucomannan (KGM)-soybean protein isolate (SPI) as wall materials. J. Funct. Foods. 83, 104542.https://doi.org/10.1016/j.jff.2021.104542.
10. Delima, R., Sahira, S., Sumiroyani, S., Kamelia, K., Reskiana, R., Rahmi, K.A., Marta, E., 2022. The impact of using salt on drying rate of fish. Int. J. Nat. Sci. Eng. 5(3), 87–95.https://doi.org/10.23887/ijnse.v5i3.41314.
11. DISKOMINFO, 2021. Usaha ikan asin di Mekarasih-Jatigede. Disk. Kabupaten Sumedang.:1. [diunduh 2023 Jan 20]. Tersedia pada: https://sumedangkab.go.id/berita/detail/usaha-ikan-asin-di-mekarasih-jatigede
12. Geffken, R., Hendrik, Zulkarnain, 2016. Analisis usaha pengolahan ikan asin di Kelurahan Pondok Batu Kecamatan Sarudik Kota Sibolga Provinsi Sumatera Utara. J. JOM. 4(1), 1–9.
13. Di Giorgio, L., Salgado, P.R., Mauri, A.N., 2022. Fish oil encapsulated in soy protein particles by lyophilization. Effect of drying process. J. Sci. Food Agric. 102(1), 206–213.https://doi.org/10.1002/jsfa.11347.
14. Hamdani, Rizal, T.A., Muhammad, Z., 2018. Fabrication and testing of hybrid solar-biomass dryer for drying fish. Case Stud. Therm. Eng. 12, 489–496.https://doi.org/10.1016/j.csite.2018.06.008.
15. Hatta, M., Syuhada, A., Fuadi, Z., 2019. Sistim pengeringan ikan dengan metode hybrid. J. Polimesin. 17(1), 9–18.
16. Herawati, T., Yustiati, A., Nurhayati, A., Mustikawati, R., 2018. Proximate composition of several fish from Jatigede Reservoir in Sumedang District, West Java. In: IOP Conference Series: Earth and Environmental Science. 137, 012055.
17. Kiranoudis, C.T., Maroulis, Z.B., Marinos-Kouris, D., Tsamparlis, M., 1997. Design of tray dryers for food dehydration. J. Food Eng. 32(3), 269–291.https://doi.org/10.1016/S0260-8774(97)00010-1.
18. Mardiono, Jacoeb, A., Nurjanah, Hidayat, T., Perdiansyah, R., 2020. Komposisi kimia dan profil asam lemak ikan layur segar penyimpanan suhu dingin. J. Pengolah. Has. Perikan. Indones. 23(1), 147–157.https://doi.org/10.17844/jphpi.v23i1.31057.
19. Misha, S., Mat, S., Ruslan, M.H., Sopian, K., Salleh, E., 2013. Review on the application of a tray dryer system for agricultural products. World Appl. Sci. J. 22(3), 424–433.https://doi.org/10.5829/idosi.wasj.2013.22.03.343.
20. Mujumdar, A.S., Devahastin, S., 2008. Fundamental principles of drying. Free. Dry.:1–22.
21. Ndahawali, D.H., Ondang, H.M.P., Tumanduk, N., Ticoalu, F., Rakhmayeni, D.A., 2018. Pengaruh lama waktu pengasapan dan waktu penyimpanan terhadap kandungan gizi ikan tandipan(Dussumieria SP). Front. J. SAINS DAN Teknol. 1(3), 274–282.https://doi.org/10.36412/frontiers/001035e1/desember201801.05.
22. Ramos, F., de, M., Silveira Júnior, V., Prata, A.S., 2021. Impact of vacuum spray drying on encapsulation of fish oil: Oxidative stability and encapsulation efficiency. Food Res. Int. 143, 110283.https://doi.org/10.1016/j.foodres.2021.110283.
23. Rani, R., Sholihah, N., Mutmainah, F., Sopiah, S., Rahmi, R., Aisyah, N., Marta, E., 2022. The impact of drying and salting on the fish resilience and quality. Int. J. Nat. Sci. Eng. 6(1), 30–36.https://doi.org/10.23887/ijnse.v6i1.41473.
24. Rinda, R.S.P., Imam, Sudarni, P.F., 2021. Perancangan dan pembuatan mesin pengering ikan asin tipe rak dengan kapasitas 20 kg menggunakan bahan bakar gas. AL-JAZARI J. Ilm. Tek. MESIN. 6(2), 57–63.https://doi.org/10.31602/al-jazari.v6i2.6050.
25. Sabilah, A., Khairunnisa, A., Monalia, M., Sahriani, S., Putri, W.P.S., Lubis, Y.A., Marta, E., 2022. The effectiveness of using direct sunlight on the drying process of salted fish without formalin. Int. J. Nat. Sci. Eng. 6(1), 14–20.https://doi.org/10.23887/ijnse.v6i1.41471.
26. Setyawan, E.Y., Siagian, P., Widodo, B., Prihatmi, T.N., Suwandono, P., Siagian, L., Gultom, T., 2018. Performance of turmeric dryer cabinets with LPG fuel using temperature control and air speed. In: IOP Conference Series: Materials Science and Engineering. 420, 012044.

27. Shirkole, S.S., Mujumdar, A.S., Raghavan, G.S.V., 2023. Drying of foods: principles, practices and new developments. In: Drying Technology in Food Processing: Unit Operations and Processing Equipment in the Food Industry. 3–29.
28. Taniyo, W., Salimi, Y.K., Iyabu, H., 2021. Karakteristik dan aktivitas antioksidan hidrolisat protein ikan nike (Awaous melanocephalus). Dalt. J. Pendidik. Kim. dan Ilmu Kim. 4(2), 52–63.https://doi.org/10.31602/dl.v4i2.5935.
29. Tenyang, N., Ponka, R., Tiencheu, B., Djikeng, F.T., Womeni, H.M., 2020. Effect of traditional drying methods on proximate composition, fatty acid profile, and oil oxidation of fish species consumed in the far-north of cameroon. Glob. Challenges. 4(8), 2000007.https://doi.org/10.1002/gch2.202000007.