Development and Fabrication of a 2- In-1 Food Dryer

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Abstract
A 2-in-1 food dryer is a composition of two old/junk refrigerator boxes, which developed to operate two processes of preserving food products (Drying and smoking) at the same time with one source of fuel.The study was developed at Mariano Marcos State University,College of Industrial technology,Laoag City, through the following methods: designing,fabrication,testing and evaluation. Materials used are two old/junk refrigerator boxes as the main frame and other locally available stainless steel/sheet .The dryer have four main parts: Dryer box, Smoke box,Fuel box and Smoke duct.The dryer and smoke box are generally known as the dryer and smoking chamber with same features as: a height of 120 cm and 60 cm square width, Chimneys on top, six stainless racks ,aluminum screen mesh and bamboo trays sliding on it and thermometer/temperature gauges.Meanwhile,The fuel box is slidably in form positioned at the bottom of the dryer box, having a capacity of 5 kg fuels.The smoke duct positioned in-between the boxes, serve as the bridge of extra heat and smoke being produce during drying process and travel to the smoke chamber for smoking process.In terms of capability, the food dryer was evaluated and compared to sun drying method and dryer/smoke device of MMSU. Food products were used as samples : Anchovy *(stolephorus ronquillos)* Squid *(Ommastrephes spp.) Scad (Decapterus sp.)* Mango *(Mangifera indica)* Rice *(oryza sativa), Malunggay (Moringa oleifera).*Based on the data obtained, the food dryer was advantageous in terms of processing time,operation method,rate of production and economic viability. As for its commercial viability, entrepreneurs/villages could very well benefit since, cost of fabrication for the 2-in-1 food dryer is only Php. 20,750.00. Moreover, An ordinary welder man can easy replicate the device within 2 days.

Keywords: 2-in-1 food dryer device, food dryer, dryer box, dryer chamber, smoke box, smoke chamber

1. INTRODUCTION

In the advent of a worsening situation of our economic growth in the country today, there is an urgent need to seek alternatives on how to cope with it. Other people may find themselves looking for a greener pasture abroad. Others have to work up in the land due to lack of resources to swing them away from this bondage. However, efforts to look for relief and provide our populace a second option to survive are a continuing endeavor. The government is committed through its support to research and development particularly on such project that could help alleviate economic poverty conditions. The 2-in-1 food dryer is just one product of such efforts. The principal researcher himself is a victim of poverty realized that with this innovation, he and his co-faculty researchers in the college had find way to help the government and the Filipino people to live in a better way. It is at this juncture, that they developed a 2-in-1 Food Dryer constructed out of old/junked refrigerator boxes.

Why old or junked refrigerator boxes?

Refrigerator boxes are totally sealed and easier to control the inside temperature (ww@yahoo.boggle refrigerator history. com. 2008). Old or junked refrigerators are available everywhere; to the junks shops, Refrigeration shops, backyard of houses and even to the garbage. Although refrigerator boxes are junked for many years they are still durable, easier and economical to be re-cycled as a functional dryer (ww@yahoo.boggle drying food. com. 2008)

In consonance to the Ecological Solid Waste Management Act of 2000, wherein Republic Act 9003, aiming for the reduction of solid waste through "source reduction and waste minimization measures including composting, recycling, re-use, recovery, green charcoal process and others before collection, treatment and disposal in appropriate and environmentally sound solid waste management facilities in accordance with ecologically sustainable development principles" (Sec.2-C). The development of such 2-in-1dryer device may help in implementing RA 9003.

In relation to the drying method of products in the Philippines, most of the poor villagers used the traditional style of sun drying method in drying food products which is unsafe and unsanitary in form and very hectic method due to sun rays exposure of the worker and very hard to predict the temperature. Solar drying is become also popular to some villages and very inexpensive method but due to its dependable to the sun heat, solar drying is somehow not feasible (James,1983).

1.1 RELATED LITERATURE

One of the methods which is indispensable for preserving food products like fish and meat that was discovered before was the used of salt (Espejo 1998). While others they preserve food products through sun drying. As lifestyle change and with the advancement of science and technology, lot of researchers discovered new type of preserving foods using sun energy, fuel energy, electric energy and chemicals. These methods still needs improvement due to drawbacks that make the process inefficient and uneconomical.

1.1.1 HISTORY OF PRODUCT PRESERVATION

Heavy losses of food products are due to microbial growth. Generally, due to the mishandling of fresh products, contamination is at great risk. These contaminations are brought by micro-organisms which include general pollution as caused by human, animals and agricultural waste (Rasco et al.. 2001) For this reason, the preservation of fish harvest is of great importance.

1.1.2 TECHNOLOGY OF PRESERVATION

An indispensable way of preserving food products is the sun drying. While it is time that the cost of sun drying is low, there are significant losses due to spoilage and contamination caused by dust, insect infestations, etc., particularly when the product is laid close to the ground. (James 1983)

Another method is the use of solar drying; this method is also known as simple and inexpensive technology in terms of capital input and operating cost. This method relies on weather condition and time of the day which requires a larger spare than other methods

(Brenndorfer et. al., 1985) The problem is when the weather is not good the sun could not heat the solar driers. (http.//www.nap.edv/openbook/ 0309037883/htl/142html.)

In most developing countries, they use devices and equipment by using electric energy like the dehydrators equipment which is computerized in manipulation (Krasemann reports at three men/ html).Ordinary entrepreneurs can not afford this kind of devices.

In the Philippines, most of the villages contented with the sun drying or by simply hanging the products on top of their stove made of concrete cement or clay, or even to lay their products on top of their houses. These creative methods are at no cost but poor quality product output. (Hill J. Padilla).

Another in demand way of fish preservation is through smoking. Smoking the product may enhance the flavor of the products during consumption and for prolong preservations; it is very effective to kill bacteria or microorganism.

In our country, a little creativeness on the empty drum of oil, ceramic jars that hollow inside or tanks or even cement formed as pugon are enough to be used as smoking devices (Padilla, Retrieved from htpp:11ww.fao//docrep/006/ ad 095elAD096EO3,htm). This output of creativeness still needs little enhancement to meet the demand and quality of the output products.

Throughout the years, local fishermen have been smoking drying, salting, and fermenting their surplus fish as a way of preserving and storing them for future use or for the market. Among these traditional methods, drying and smoking are the simplest and widely used by local fisher folks. These do not only prolong the shelf life of the product but they also reduce waste at times of abundant catch and permit storage for the lean season.

These related literature provided the foundation of the conceptualization of the 2-in-1 food dryer which can enhance the technology of preserving food products. It can change the lifestyle of poor Filipino families and can adopt and encourage entrepreneurs that could uplift the economic condition of one town or even one community.

1.2 OBJECTIVES

This study was conducted generally to develop a 2-in-1 Food Dryer for drying and smoking different food products with a features of: durability to its function, easy to fabricate, less cost for the construction,adaptation for villagers is possible,Help in the implementation of RA 9003 and can ensure cleanliness output products with the desired length of operation.

Specifically, it answered the following:

1. To develop and fabricate a 2-in-1 food dryer out of an old/junk refrigerator boxes as the main frame.
2. To determine the efficiency of the dryer in terms of :
    a. Economic viability in the materials use and cost of fabrication
    b. Economic viability in the fuel consumption and production rate every cycle of operation
    c. Comparison of the newly develop 2-in -1 dryer to the ff:
    - Traditional sun drying
    - Existing dryer/smoke device

1.3 SIGNIFICANCE OF THE STUDY

The development of the 2-in-1 food dryer is beneficial to the country and to the people whose lives are dependent on this trade(drying and smoking food products).This will open better alternative to Filipino workers of dried and smoke products who are used too poorly designed,dilapidated and slow performing devices.

As a breakthrough, the food dryer is capable of performing two processes of preservation(Drying and Smoking) at the same time with one source of fuel.This design of the device will triple the output product and profit of the worker while minimizing fuel consumption.

Fabrication of the device will give opportunity to the fabricators and welder men to increase their income while Refrigeration Shops can convert their junk refrigerators into useful device and this in other way, it help the Government in the implementation of Ecological Waste management.

2.METHODOLOGY

2.1 DESIGN AND FABRICATION

The study was develop in two stages: Stage 1 in which sketching,lay-outing,construction and pre-testing of the device are involves while the stage 2 ,are the testing and evaluation of the capability of the device in terms of its economic viability of materials use in the fabrication,fuel consumption,production rate and its advantageous compared to sun drying and to the existing dryer/smoke devices. Figure 1,is the operational framework of the study.

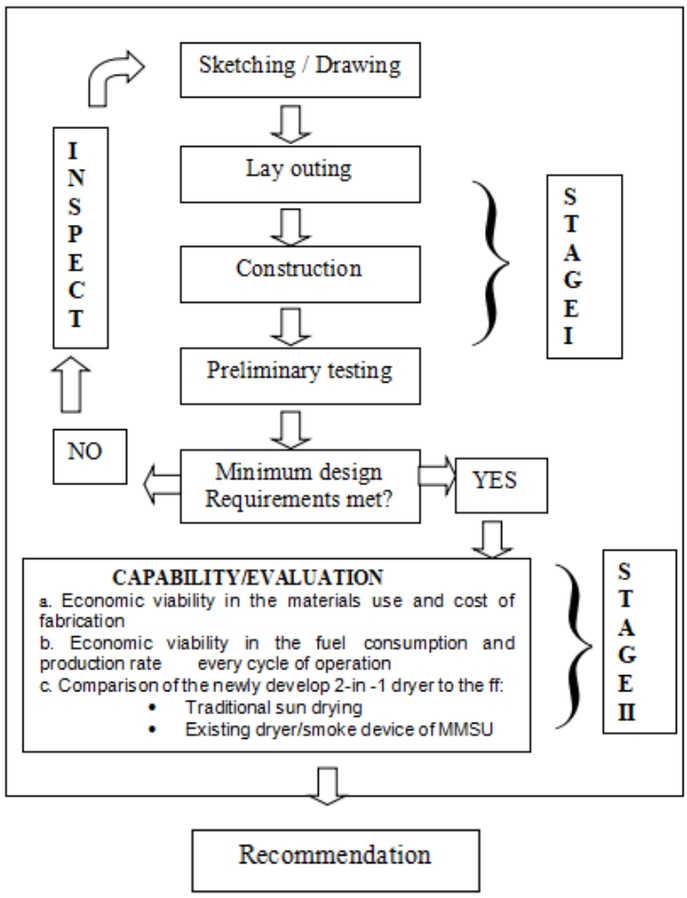

Fig. 1. Operational framework of the Study

2.2 WORKING DRAWING OF THE 2-IN-1 FOOD DRYER

The figure below shows the dimension of the device with a total height of 144cm, length of 179 cm and width of 61 cm.

Figure 3, shows the front view of the device (Parts description are shown at appendix I).

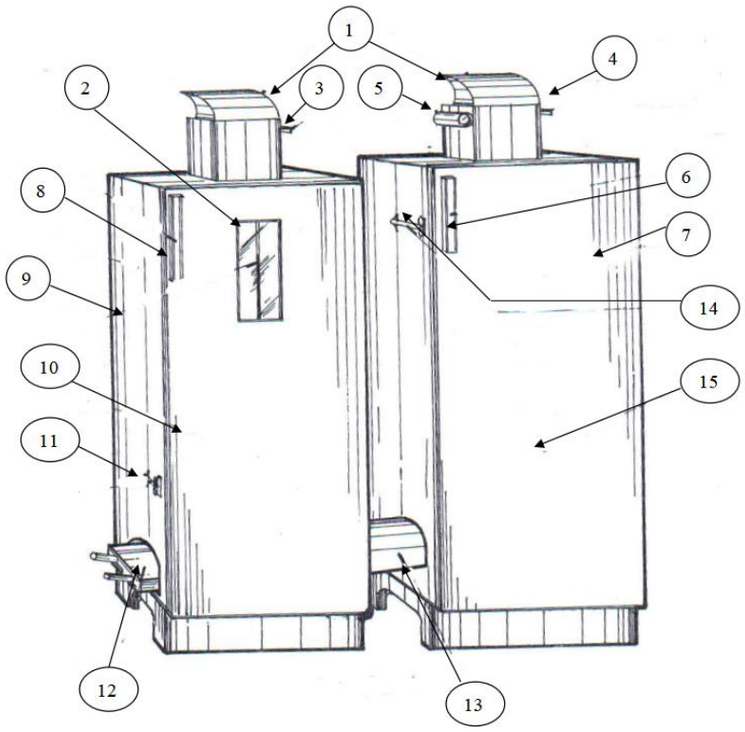

Fig. 3. Front View of the 2-in-1 Food Dryer

Figure 4, shows the sectional view of the device (Parts description are shown at appendix I).

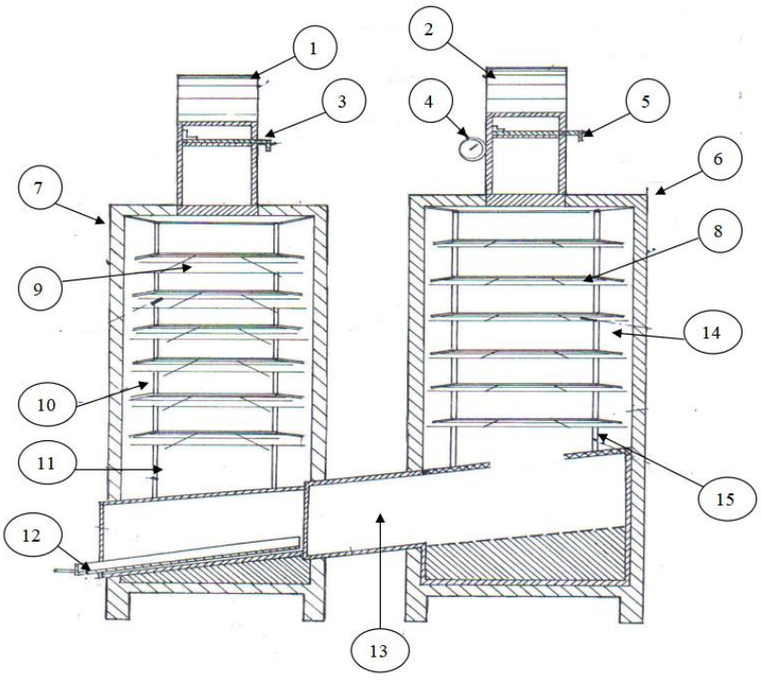

Fig. 4. Sectional View of the Food Dryer

Figure 5, is the sectional and top elevation view of the device (Parts description are shown at appendix I).

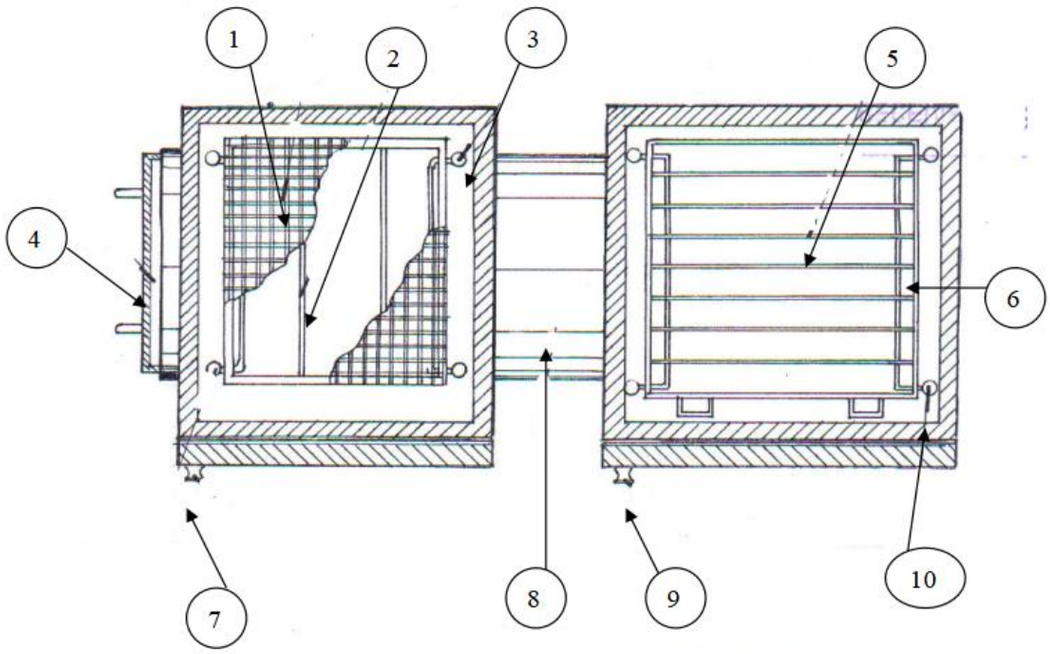

Fig. 5. Sectional View and Top Elevation of the Food Dryer

Figure 6 shows the sectional view of the charcoal pan and sliding tray of the device. (Parts description are shown at appendix II).

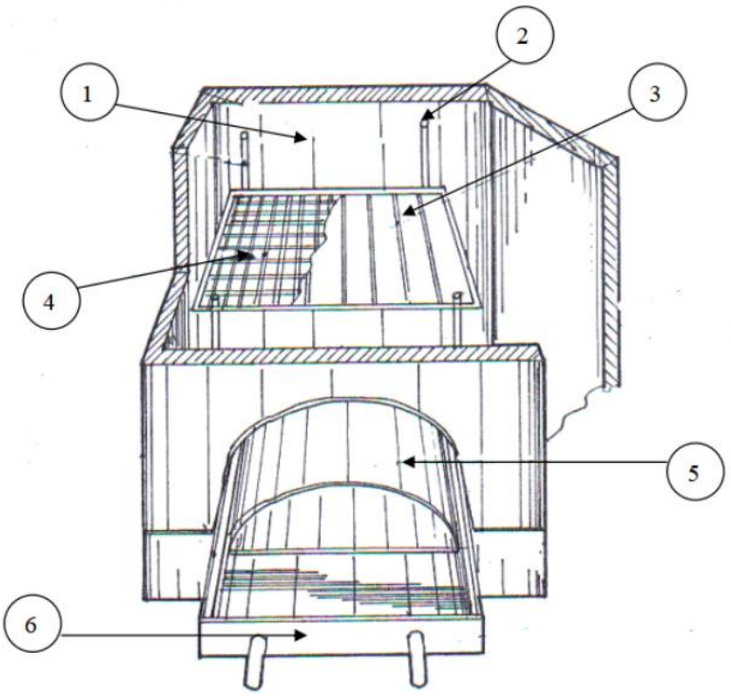

Fig. 6. Sectional View of the Charcoal Pan and Sliding Tray of the 2-in-1 food dryer

Figure 7 is the sectional view of the built-in rack of the device (Parts description are shown at appendix II).

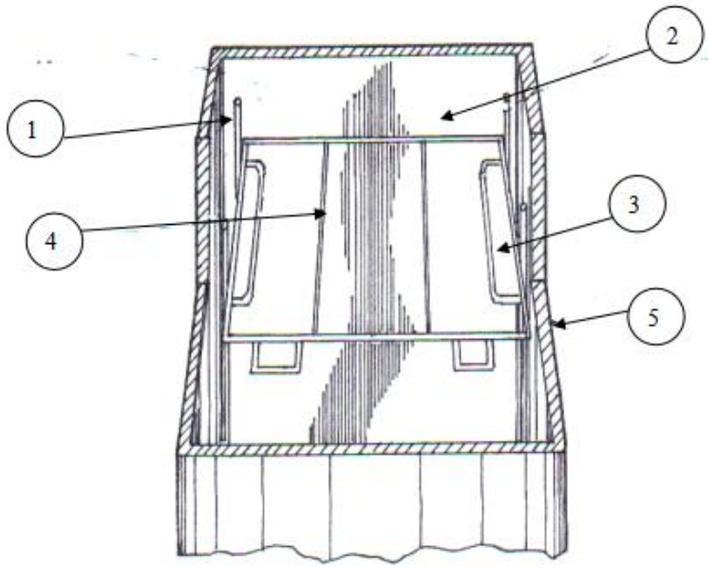

Fig. 7. Sectional View of the Built-in Rack of the Food Dryer

Figure below is the fabrication process of the device.

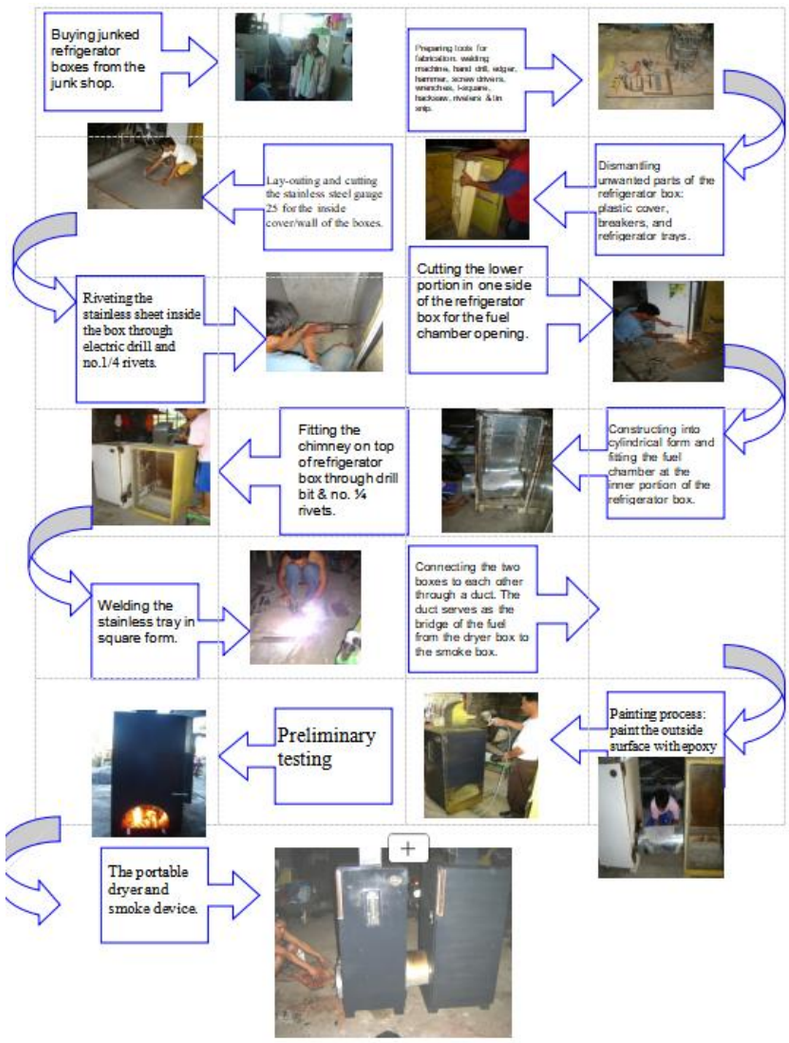

Fig. 8. Flow of fabrication of the 2-in-1 food dryer

2.3 PRODUCTS AND SAMPLES USE

The product sample use in the evaluation of the effectiveness of the 2-in-1 Food dryer are anchovy *(stolephorus ronquillos*) squid (*Ommastrephes spp*.) *scad (Decapterus sp*.) Mango (*Mangifera indica*) rice (*oryza sativa*), *Malunggay (Moringa oleifera).* The fuel used are hard woods/charcoal and sawdust/rice hull.

2.4 OPERATIONAL DEFINITION

Cost of fabrication. It refers to the expenses incurred in the production of the 2-in-1 Food dryer which includes cost of materials and labor.

Drying. It refers to the process of reducing the water content of a certain food material to lengthen its keeping quality.This usually involves natural drying under the sun.

Dehydration. Is artificially done in mechanical or powered equipment. (Von,1995)

Fabrication. In this study, it refers to the process of producing a new device, such as the 2-in-1 food dryer, which includes lay-outing,designing and constructing the device and trying out.

Rate of production. It refers to the working performance of the device in terms of speed and volume of production.

Smoking. This is the process of applying hardwood smoke to impart a smoky flavor to, and dry the fish to extend its shelf life with aroma.

3. RESULTS AND DISCUSSION

3.1 RESULTS OF FABRICATION

The 2-in-1 food dryer is unique in design as compared to other dryer devices. The device is constructed out of old/junked refrigerator boxes which is develop as dryer and smoke device through innovating the inside parts and change with stainless sheet and steel as the inside wall cover and staggered racks. The process of fabrication is easier and the length of time of construction can be obtained within two days if materials are complete with basic tools needed for the fabrication. The material needed is locally available in the market like the stainless sheets gauge .22 and stainless steel .25. Below is the pictorial view of the 2-in-1 food dryer.

Fig. 9. Pictorial view of the 2-in-1 Food Dryer

The left box is the dryer box or dryer chamber with a height of 120 cm and 60 cm square width, having a chimney on top use as the exhaust. Also a thermometer is attached to the door of the dryer box for monitoring the inside temperature. The box in the right is the smoke box or smoke chamber. The smoke box has the same height and length with the later box having a chimney on the top use to control the density of smoke and temperature inside the chamber. It is also equipped with a temperature gauge attached to the chimney to monitor the inside temperature.

A duct is placed between the dryer and smoke box which serve as the bridge of the heat and smoke from the fuel box of the dryer chamber that pass through the smoking chamber via the said duct. This compensate the idea of the device as 2-in-1 wherein only one source of fuel is used while processing dried and smoked product at the same time. Below is the side view of the dryer box.

Fig. 10. Side view of the 2-in-1 Food Dryer

The picture shows the side view of the dryer box with the location of the fuel box. The fuel box is formed like an open box side by side for proper ventilation of the fuel with 1.5 x 2 x .5 feet as width, length and height, having a fuel capacity of 4 kg either wood, charcoal, sawdust and other fuel intended for the products to be dried or smoke. Below is the inside view of the 2-in-1 food dryer.

Fig. 11. Inside view of the 2-in-1 Food Dryer

Both the dryer box and smoke box is equipped with six sliding trays. The trays of the box are made up of screen mesh and stainless steel while the smoke chamber was made of stainless steel and bamboo trays. It can be seen from the picture that the fuel box positioned at the bottom part of the dryer is totally enclosed by a sheet forming into half round; this indicates that the

device is also a convection dryer type. Only the heat evaporation will pass through the product during drying while the extra heat and smoke will pass thorough the smoke chamber via a duct. In this method, the two processing could be done at the same time with less time of operation, less fuel to consume, more product output and convenient to use with more profit.

3.2 TESTING OF THE DEVICE

The following pictorial view are the basic steps in operating and using the device. Below is the pictorial view of the device in dis-assembled form.

Fig. 12. Dis-assembled form of the device into 2-in-1 food dryer

The figure shows how to assemble the device into 2-in-1.

Fig. 13. Assembling the device into 2-in-1 food dryer

The next figure shows the preparation of fuel for drying food products.

Fig.14. Preparation of fuel

Figure 15 shows how to place the charcoal in the charcoal pan.

Fig. 15. Preparing fuel in the charcoal box of the dryer box

Figure 16 is the ignition of the charcoal that being place in the charcoal box of the device.

Fig. 16. Fuel ignition

Figure 17 shows how to prepare and assemble the trays inside the dryer box and smoke box.

Fig. 17. Assembling of trays

Figure 18 shows the preparation of the Moringa leaves as the sample products to be dried.

Fig.18. Preparation of the products to be dried (Malunggay leaves (*Moringa oleifera*)

Figure 19 shows the preparation of Bangus to be smoke in the smoke chamber.

Fig. 19. Preparation of the products to be smoked, Bangus (*Chanus chanus).*

Figure 20 shows the loading of the products to the chambers.

Fig. 20. Loading the products

Figure 21 shows the preparation of sawdust fuel.

Fig. 21. Preparing the sawdust fuel

Figure 22 shows the smoke coming out from the smoke box after the sawdust are place on top of the charcoal located at the bottom of the dryer box.

Fig. 22. Generating smoke for the smoking process

Figure 23 shows after 15 minutes the moringa (Moringa Oleifera) leaves is already dried.

Fig.23. Moringa (Moringa Oleifera) dried product.

Figure 24 shows the preparation of the 2nd batch of products to be dried in the dryer box.

Fig. 24. Rice (Oryza sativa)

Figure below shows the product (Bangus) being smoked in the smoke box of the device after 45 minutes.

Fig. 25. Smoked output product (Milkfish/ *Chanos chanos)*

Figure 26 shows that after 2 hours of operation of the device, the 2nd batch of products is already dried.

Fig. 26. The dried rice after 2 hours

The last figure shows the 2-in-1 operation of the device wherein drying and smoking process is at the same time in operation with only one source of fuel.

Fig. 27. The device working in two process (drying while smoking food products)

Note: The device can work the whole day or night with two cycle of drying operation in every 8 hours with a total output of 40 kg dried fish and 200 kg smoke fish.

3.3 EVALUATION ON THE EFFICIENCY OF THE 2-IN-1 FOOD DRYER

The following tables are shown as evidence of the efficiency of the 2-in-1 food dryer in terms of drying different food products and in comparison with the traditional sun drying method of drying and the existing device used in drying and smoking.

Table I**.** Economic viability of the 2-in-1 food dryer in terms of materials used and the cost of fabrication.

Item	Amount spent
Materials	15,000.00
Labor (35% of material cost)	5,250.00
Miscellaneous expenses	500.00
Total cost	Php. 20,750.00

The total cost of fabrication was Php 20,750.00 in 2007 which is much cheaper than any existing dryer

Table II. Economic viability of the 2-in-1 food dryer in terms of fuel consumption and production rate everyday.

Item	Output
Drying process*	40kg dried products
Smoking process*	200 kg smoke products
Fuel used	8 kg of charcoal = P 96.00

The table shows that in a day of operation there is an output product of 240 kg with 8 kg charcoal use (Sawdust is considered as free).

*Dryingprocess: At two cycle operation every 8 hours/day operation with four hours every cycle.

*Smoking process: In everyday operation of drying process,there are four cycle for smoking process,equivalent of 2 cycle of operation per operation of dryer box.

Table III. Evaluation of the effectiveness of the traditional sun drying method in drying anchovy *(stolephorus ronquillos*) squid (*Ommastrephes spp*.) *scad (Decapterus sp*.) Mango (*Mangifera indica*) rice (*oryza sativa*), *Malunggay (Moringa oleifera).*

Sample product	8:30 AM. (36 ˚C) Fresh weight (kg)	9:30 AM. (38 ˚C) Weight (kg)	10:30 AM. (40 ˚C) Weight (kg)	11:30 AM. (41 ˚C) Weight (kg)	12:30 AM. (43 ˚C) Weight (kg)	1:30 AM. (42 ˚C) Weight (kg)	2:30 AM. (41 ˚C) Weight (kg)	3:30 AM. (40 ˚C) Weight (kg)	Hour Total Hour	Weight Total after drying Weight (kg)
Anchovy	10	9.75	9.25	8.55	7.60	6.15	6.15	-	6	6.15
Squid	10	9.85	9.55	9.10	8.40	7.20	7.20	-	6	7.20
Scad	10	9.90	9.75	9.5	8.0	7.40	7.25	7.25	7	7.25
Mango	3	2.85	2.4	1.75	.95	.95	-	-	5	.95
Rice	7	6.95	6.25	5.25	3.75	3.75	-	-	5	3.75
Malunggay	3	2.95	2.80	2	.8	.80	-	-	5	.80

Based from the data obtained in using the traditional sun drying method of drying fish it has a total time of approximately 6.7 hours with variable temperatures having 3-4 kg less weight

During the testing, the mango and rice was used as sample for fruit products and it consumed 5 hours for drying with 2.4 kg less weight after drying. Likewise, the *malunggay* was also used for leaves sample and has a drying time of 5 hours with 2 kg less weight after drying.

Moreover, the anchovy, squid and *scad* were used as fish samples. The anchovy and squid were dried for 6 hours while the *scad* took 7 hours to dry with 3-4 kg less weight after drying.

Table IV. Evaluation of the effectiveness of the dryer/smoke device of MMSU (DSD) in drying anchovy *(stolephorus ronquillos*) squid (*Ommastrephes spp.) scad (Decapterus sp.)* Mango *(Mangifera indica)* rice *(oryza sativa), Malunggay (Moringa oleifera)*

Sample product	8 PM. (50 ˚C) Fresh weight (kg)	8:30 PM. (50 ˚C) Weight (kg)	9:00 PM. (50 ˚C) Weight (kg)	9:30 PM. (50 ˚C) Weight (kg)	10:00 PM. (50˚C) Weight (kg)	10:30 PM. (50˚C) Weight (kg)	11:00 PM. (50˚C) Weight (kg)	11:30 PM. (50 ˚C) Weight (kg)	12:00 PM. (50 ˚C) Weight (kg)	Hour Total Hour	Weight Total after drying Weight (kg)
Anchovy	10	9.50	8.55	7.65	6.80	6.10	6.10	-	-	3	6.10
Squid	10	9.75	9.20	8.60	7.00	7.45	6.95	6.95	-	3.5	6.95
Scad	10	9.80	9.30	8.80	8.40	8	7.60	7.20	7.20	4	7.20
Mango	3	2.85	2.35	1.95	1.55	1.15	.75	.75	-	3.5	.75
Rice	7	6.80	6.25	5.25	4.25	3.65	3.65	-	-	3	3.65
Malunggay	3	.70	.70	-	-	-	-	-	-	1.5	.70

It can be gleaned from Table IV that the drying time of the DSD for fish with at least 50 ˚C control temperatures was approximately 4-3 hours with 3-4 kg less weight after dry.

On the other hand, drying of fruits using the same device had an approximate total time of 3-3.5 hours with a less weight of 2.4 kg after drying while the *malunggay* leaves was dried at approximate time of 15-30 minutes with a less weight of 2 kg.

Table V. Evaluation of the effectiveness of the 2-in-1 food dryer (2-in-1 FD) in drying anchovy *(stolephorus ronquillos)* squid *(Ommastrephes spp.) scad (Decapterus sp.)* Mango *(Mangifera indica)* rice *(oryza sativa), Malunggay (Moringa oleifera).*

Sample product	8 PM. (50 ˚C)	8:30 PM. (50 ˚C)	9:00 PM. (50 ˚C)	9:30 PM. (50 ˚C)	10:00 PM. (50˚C)	10:30 PM. (50˚C)	11:00 PM. (50˚C)	11:30 PM. (50˚C)	12:00 PM. (50 ˚C)	Hour Total	Weight Total after drying
	Fresh weight (kg)	Weight (kg)	Weight (kg)	Weight (kg)	Weight (kg)	Weight (kg)	Weight (kg)	Weight (kg)	Weight (kg)	Hour	Weight (kg)
Anchovy	10	9.50	8.55	7.65	6.80	6.10	6.10	-	-	3	6.10
Squid	10	9.75	9.20	8.60	7.00	7.45	6.95	6.95	-	3.5	6.95
Scad	10	9.80	9.30	8.80	8.40	8	7.60	7.20	7.20	4	7.20
Mango	3	2.85	2.35	1.95	1.55	1.15	.75	.75	-	3.5	.75
Rice	7	6.80	6.25	5.25	4.25	3.65	3.65	-	-	3	3.65
Malunggay	3	.70	.70	-	-	-	-	-	-	1.5	.70

It is interesting to note in Table V that the drying time of the newly developed 2-in-1 food dryer with at least 50˚C temperatures was approximately 3-4 hours drying with at least 3-4 kg less weight after the operation.

Likewise, in drying the fruit products it consumed 3 – 3.5 hours with a less weight of 2-4 kg after drying while the *malunggay* leaves was dried at approximate time of 15- 30 minutes with a less weight of 2 kg.

Table VI. Difference between the sun drying method, Dryer/smoke device of MMSU(DSD) and 2-in-1 food dryer (2-in-1 FD) in every 8 hrs operation in turns of drying time, smoking time product output, fuel consumption using *scad* as sample.

Drying /Smoking Method	Drying time in every cycle	Smoking time in every cycle	Dried output product in 8 hrs.	Smoke output product in 8 hrs	Total cycle every 8 hrs	Total output product in every 8 hrs. operation	Total fuel consumption (Charcoal & Sawdust)
Sun drying	7	N/A	indefinite	N/A	1	Indefinite dried output	N/A
DSD	4	1	20 kg	80 kg	1 cycle of drying & 4 cycle of smoking	100 kg	17 kg charcoal 8 kg sawdust
2-in-1 FD	4	.45	40 kg	200 kg	2 cycle of drying & 10 cycle of smoking	220 kg	17 kg charcoal 8 kg sawdust

It can be gleaned from Table VI that the difference of the product output between the traditional sun drying method and the 2-in-1 FD was comparable due to wide range of space for sun drying. There was no limit for sun drying. The total product output for every 8 hrs of operation was indefinite. The traditional sun drying can not be used for smoking.

On the other hand, the difference between DSD and 2--in-1 FD in drying output product for every 8 hrs of operation or 2 cycle of operation has a difference of approximately 20 kg for drying and 120 kg in the smoking process.

The significant difference between the 2-in-1 FD and DSD is the 2-in-1 FD doubled or even tripled the output product due to its novel design for dual purpose (drying and smoking process at the same time) while the DSD can only process products (drying and smoking) in different operations.

3.4 SOCIO ECONOMIC SIGNIFICANCE OF THE DEVICE

Capital input

- **1 unit 2-in-1 food dryer** = Php. 20,750.00

- **Material cost per day of operation:**

Drying process:

- 40kg fresh fish @ Php. 80.00 / kg = Php3,200.00
- 10 kg salt @ Php. 10.00 /kg = Php 100.00
- 8 kg of charcoal @ Php. 12.00/kg = Php 96.00

Total = Php 3,396.00

Smoking process:

- 200 kg fresh fish @ Php. 100.00/kg = Php 20,000.00
- 40 kg salt@ Php. 10.00/kg = Php. 400.00
- Sawdust = (considered as free, as a recycle one from lumber)
- Charcoal =(considered as free because the fuel used by the dryer chamber is also the fuel of the smoke chamber as 2-in-1 food dryer)

Total = Php 20,400.00

- **Gross per day of operation**:
- dried products @ Php. 160.00 /kg x 35 kg with 5 kg. less weight after drying = Php 5,600.00
- smoke products @ Php 150.00 /kg x 200 kg = Php 30,000.00

Total = Php 35,600.00

- **Net profit per day of operation**:
- Less expenses: Material cost per day = Php. 23,796.00
  : Labor cost@ Php 8.00/kg = Php 1,880.00

Total = Php 25,676.00

Net profit = Gross sales – cost of operation
= Php 35,600.00 – 25,676.00
= Php 9,924.00

Note: Pay back period of one unit of the 2-in-1 food dryer:
= Net investment/net frofit daily
= 20,750/9,924
= 2

Based on the computation, the entrepreneur could very well benefited using the device in processing dried and smoke food products with an average of Php 10,000.00 net profit per day of operation with 2 days pay back period of the 2-in-1 food dryer.

4.CONCLUSION

The existing devices for processing dried and smoke products are everywhere for commercialization, hence, the 2-in-1 food dryer will be having more potential for commercialization due to its novel design, cheaper, economical and affordable to small capital entrepreneurs with a Php20,750 cost of fabrication and it can be lower the cost through availing the junk/old refrigerator box as free.

Other devices for drying and smoking food products are constructed couple of months, other types like power generated dryer need special fabrication shop or plant for construction.

The new develop 2-in-1 food dryer is simple and easy to fabricate. An ordinary welder or fabricator can assemble the device in two days and serve as their additional source of income.

The recycled and delapidated refrigerator boxes can help implement the Ecological Solid Waste Management because old/junked and unserviceable refrigerators are being recycled, reused and recovered.

Moreover, the Refrigeration and Air-conditioning shops may solve their problem on limited space by selling their junk refrigerator to fabricators and small capital entrepreneurs could avail or make their own device because it is easier to fabricate and economical in terms of fuel

4.1 RECOMMENDATION

In the light of the findings and conclusion: the researchers offers the following recommendations:

1. Dissemination of the study to the welders/fabricator for immediate replicability and mass production of the device.

2. A follow up study on the other products to be dried and smoke in the device .

3. A new innovation for the device for other function.

REFERENCES

Espejo –H.J. (1998) Fish Processing Technology in the tropics.

Fernandez, Zaldy A. (2005) Fabrication of a Prototype 4 in 1 Smoke Processor. Unpublished Master's Thesis. Mariano Marcos Sate University, Laoag City.

Fishers technologies for developing countries. Retrieved March 06,2001, from http.//www.nap.edv/openbook/ 0309037883/htl/142html.1988.

James,D. (1983) The Processing and Storage of Dried Fish. (Fisher's Report 27-9) FAO, Rome Italy.

Padilla, H. J. Stove for smoked fish making. Retrieved August 01, 2005 from http.//www.FAO.org//docrep/ 006/ ad095e/AD095E03.htmL.

Rasco BA, Gerald WA, & Bledsol GE (2001). Frozen Aquatic Food Products. Introduction to Food Chemistry, West Sacramento (CA): Science and Technology System.

Von L.H.W. (1955): Drying & Dehydration of Foods. New York: Reinhold Publishing Corporation.

Whitman, William C & Johnson, William M. (1987) Refrigeration and Air-Conditioning Technology Concepts, Procedure and Trouble Shooting Technology.