

Development of education module on eco friendly Energy conservation indigenous equipment-Hay Box

FINAL REPORT OF MINOR RESEARCH PROJECT

DEVELOPMENT OF EDUCATION MODULE ON
ECOFRIENDLY ENERGY CONSERVATION INDIGENOUS
EQUIPMENT- HAY BOX

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**FINAL REPORT OF A MINOR RESEARCH PROJECT
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1. INTRODUCTION

Energy crisis is the significant problem, that world is going to face in the near future. India derives the bulk of its cooking energy needs from solid fuels, such as firewood and cattle dung. On the contrary, economically developed countries, such as the USA, UK, Italy, Denmark and others use cleaner cooking fuels.

India also displays a striking rural-urban dichotomy in its choice of cooking fuels. An overwhelming majority about 80% of rural homes in India continue to use biomass firewood, crop residue or cow dung as their primary cooking fuel. This resource is available at almost no out-of-pocket cost a factor that explains its high usage rate, even though firewood and cow dung are cumbersome to obtain and use. No withstanding the health hazards of the resultant smoke pollution, the 'free' factor appears to override all other considerations. Many rural homes lack a closed kitchen and cooking is often done in an open area, which, to some extent, mitigates the impact of the smoking chulha (local parlance for 'cooking stove').

Urban India, on the other hand, opts for cleaner and convenient cooking fuels. Liquefied petroleum gas (LPG), marketed in portable cylinders lights the

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fire in over 59% of urban Indian kitchens. Many more are using cleaner fuel each year, thereby moving away from kerosene stoves and firewood or cow-dung fuelled chulhas.

Liquefied Petroleum Gas (LPG) is increasingly becoming the preferred choice of fuel in the world. The increase in patronage could be attributed to its affordability, efficiency and environmental friendliness. Like other energy sources, there are challenges that impede the smooth supply of LPG resulting in shortage. Several factors are involved which ultimately affects the efficiency of the entire Supply Chain system.

Therefore, the study seeks among others to investigate the magnitude of noted disruptions that contribute to the shortage of LPG and the extent to which the LPG usage categories influence the length and frequency of shortage. A survey methodology was deployed for a total of 35 LPG retailers and 120 consumers in the Ashanti Region of Ghana. Results of the study indicated that the Technical and Transportation disruption was ranked by retailers and consumers as major factors that disrupt the supply of LPG. Analysis carried out revealed that the frequency of LPG shortages experienced by consumers depends on the categories of usage, whilst the consumers' experiences of the duration for LPG shortage are rather independent on the categories of usage.

It does not matter whether you use electricity, gas, or solid fuel to cook, there can be times when fuel is scarce. At the beginning of the 20th century there was a fashion for something called fuel-less cookery. That sounds as though would save of that precious fuel.

A hay box, straw box, fireless cooker, insulation cooker, or retained-heat cooker is a cooker that utilizes the heat of the food being cooked to complete the cooking process. Food items to be cooked are heated to boiling point, and then insulated. Over a period of time, the food items cook by the heat captured in the insulated container.

Fuel-less cookery is an adaptation of a technique used by campers and others spending time outdoors called hay box cookery. Ideas for using this technique can be found in old cookery books which people might have used to help them prepare a meal to eat while on a journey or out for the day. Today, mention can be found of it on camping web sites and on sites which discuss ideas to help people make the best use of resources.

This sort of cooking is particularly suitable for stews and casseroles, although it can be used to cook soups (and the stock that is used as a base for them), rice, beetroots, and porridge. Less water is needed than for other forms of cooking as there is less evaporation.

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This is an old technique that can use literally what it says, some hay and a box. The idea is that a container of food is heated up to boiling point and then immediately placed in a box surrounded by hay as insulation.

The idea is to take a box with a tightly fitting lid and fill it with insulating material like hay. The dish rests on some of the insulating material and has some more packed around the sides so that it looks as if it is in a nest. The dish needs to have a closely fitting lid and may have a clean towel wrapped around it to protect it from any possible contamination. You need a dish rather than a pan with a long handle so that it will fit in the hay box more easily. Make sure that there is enough hay left to put over the top. If you intend doing this a few times you can get some fabric to make a bag, fill it with hay and then sew the opening to make a cushion that can be put over the top.

The food needs to be heated thoroughly to start with, which is where the idea of boiling it for 10 minutes first comes from. Once it is hot, the wrapped sealed dish is put in the box and left alone until it cooks. This leads to quite a saving in the amount of fuel used. It also means that like with a standard slow cooker, it is possible to start the cooking process for a meal a few hours before it is needed and get on with other things while it is cooking.

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It can take four times as long to cook food in a hay box than it would in the oven. Some people leave things overnight and then warm them up again whereas others say that it should not be left for more than 4 hours so that the food does not cool too much to make it into a health hazard. The "safety police" say that the food should be kept above 140 F. How quickly the food cools also depends on the temperature outside the box so it is useful to leave it in a fairly warm place.

It is important that whatever is used, not to check the food very often if at all, as this will only lead to the food cooling down so that it will not cook properly. Most of the foods that can be cooked this way don't go past their best very quickly so checking them is not really necessary. In fact, many of them improve with longer cooking.

Food cooks better if the dish is nearly full. However, it is important not to get the insulating material wet from either the steam (hence the well fitting lid) or from spilling the food, so don't overfill the dish. If hay and some other insulating materials get wet, they do not hold the heat in as well. Hay does not last well if it gets damp. A hay box left unattended for a while can look to a mouse just like a ready-made home, so be careful where you keep it.

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Some people use the traditional wooden box, possibly a tea chest, others a more modern Styrofoam box, but whatever is used it needs to be able to hold in the heat and keep out drafts. Even a cardboard box with a lid will work. The insulating material could be crumpled newspaper, wood shavings, Styrofoam peanuts, fur, wool, synthetic blankets or anything that holds in the heat. The trick is to create lots of little air pockets. The insulating material can be used again and again, although you may need to add a little more hay as time passes. It is also essential to dry out any damp insulation so that the box works well next time. If the hay box is not used for a while, make sure that the hay in it is dry because wet hay, left a long time, can catch fire.

The present study is relevant in the present context. People have to wait for long periods for LPG cylinders. Due to scarcity of this non renewable resource and it has become costlier. Hence it is important to opt other methods and sought into energy conservation techniques. Keeping this in view the particular study was undertaken to create awareness of hay box to rural people. The present study **“Development of education module on eco friendly energy conservation indigenous equipment- hay box”** was undertaken with the following objectives:

1.1 AIMS AND OBJECTIVES

- Designing and construction of hay box
- To Compare cooking time in hay box and open cooking using LPG
- To evaluate the sensory aspects of cooked food using score card
- To develop education module
- To create awareness through education class for women and college students

DEFINITIONS

1. Hay box cooking is a method of cooking done using a Hay box cooker that utilizes the heat of the food being cooked to complete the cooking process. Food items to be cooked are heated to boiling point, and then insulated. Over a period of time, the food items cook by the heat captured in the insulated container.
2. A hay box, straw box, fireless **cooker**, insulation **cooker**, wonder **oven** or retained-heat **cooker** is a **cooker** that utilizes the heat of the food being cooked to complete the **cooking** process. Food items to be cooked are heated to boiling point, and then insulated (<https://en.wikipedia.org/wiki/Haybox>).
3. Gas cooking is done using a cooker/stove which uses natural gas, propane, butane, liquefied petroleum gas or other flammable gas as a fuel source.

2. REVIEW OF LITERATURE

The review of literature regarding “Development of education module on eco friendly energy conservation indigenous equipment- hay box” is discussed under the following headings:

2.1 Energy conservation

2.2 Significance and benefits of using hay box

2.3 Hay box designing and construction and advantages

2.4 Other ideas of Developing hay box

2.1 Energy conservation

Energy conservation refers to reducing energy consumption through using less of an energy service. Energy conservation differs from efficient energy use, which refers to using less energy for a constant service. For example, driving less is an example of energy conservation. Driving the same amount with a higher mileage vehicle is an example of energy efficiency. Energy conservation and efficiency are both energy reduction techniques. Even though energy conservation reduces energy services, it can result in increased environmental quality, national security, personal financial security and higher savings. It is at the top of the

sustainable energy hierarchy. It also lowers energy costs by preventing future resource depletion (Berkely 2012).

The realisation of challenge to the sustainable development due to increased consumption of energy turned the focus of human community towards safeguarding the environment through energy conservation measures. Sen (2004) proposes the usage of renewable energy sources for sustainable development. During the last decade the rationalization and conservation of energy has been a top issue in the energy planning seminars all over the world (Felipe and Nicolás 1998).

Individuals and organizations that are direct consumers of energy may choose to conserve energy to reduce energy costs, promote economic security, or maximize profit. However, this can lead to unintended effects, which can negate environmental benefits of conservation unless backstops are instituted to prevent overall consumption increases (Ozzie, 2012)

2.1.1 Need for Conserving Cooking Gas (LPG)

“Conservation of energy “is a scientific theory that states that the total amount of energy in a system always remains constant, even though it may change forms(eg. Potential energy into kinetic energy). In this case, we don’t” need “to conserve it, it’s just a way the word works. However conservation of

energy can also refer to using as little energy as possible. This is usually discussed in terms of electricity, oil and gas. We need to conserve energy because it all comes from somewhere, and at present most of it comes from non-renewable sources such as fossil fuels. Most of the energy that is from renewable sources pollutes as much or more as fossil fuels-for example, some energy plants burn garbage or yard waste as fuel. Nuclear power is relatively clean, but has its own attendant problems. When coming to conservation, it's something we need to do to keep our planet clean and to ensure that future generations have the resources they need (Breukers and Heiskanen, 2009).

Gas which is used for burning is produced from the fossil fuels, which at the moment are decreasing at a much faster rate than they are being produced. Cow Dung is a place below earth surface where all waste of animals and rubbish from city is stored. Together the waste of animals and rubbish produces a gas called Bio-gas which can be used for burning. In the way, rubbish which is burned and makes a pollution can be made into a useful gas and our fossil fuels can be saved, making a better future for our new generations (Breukers, Heiskanen, 2009).

Electricity is produced by hydro-electric power, wind power, solar power and geo thermal power. All of these ways are expensive which neither a normal nor a poor country can afford. In poor countries the city's waste and the factories waste water is discharged into the sea, making it polluted. People drinking river

water die and marine life also cannot survive. To prevent this, all waste water can be collected in a closed place which can later be filtered. Some of this water can be send back to the city after some treatment, through pipes and the rest can be boiled in boilers tom produce steam which will run the turbine and electricity will be produced in the cheapest ways. This process can be done by poor countries and marine life will return and fewer diseases will be spread through water and the seas will remain clean (Stevens, 2001).

Another ways of conserving fossil fuels is the process of the poultry plant. In this plant the feathers of hens, which can be found in large amounts, are used to produce fuel. These feathers in water and then the water are hydrolyzed. During the hydroilization process fats from the feathers starts to float on the surface of the water. The fats are then collected and enzymes are provided to these fatty acids. The enzymes break the fatty acid into 12 –carbon and 8- carbons long chain, which are diesel and petrol respectively (Breukers, Heiskanen, 2009).

2.1.2 LPG Scarcity in India

Despite claims by the city – based LPG agencies, consumers complain that cylinders take at least 15 days to arrive from the time of the booking (Indian Express, 2012).

Till some time back there was restriction imposed by oil PSUs which allowed booking only 21 days after the delivery. In such case, those having single cylinders were in real trouble if their cylinder exhausted before 21 days and refill took more than a week. But this 21- day restriction has now been lifted by the PSUs. Consumers, however, complain that many agencies are sticking to this rule and even those who take booking before this deadline take not less than 15 days to send the refill. Availability of LPG cylinders worsened and import of the gas has been reduced with the fall in the price of rupee(Indian Express, 2012).

Consumers, who have submitted their requisition for refill,are getting delivery of the LPG cylinder only after 15 days. “In many cases it is up to 18 days. Moreover, distribution of new connections have been stopped (Indian Express,2012).

The falling price of rupee has led to under recovery in case of domestic cylinders and the government is not ready to replenish it,” he said.” The situation is getting from bad to worse. The LPG supply has dropped considerably and chances are it will get worse in the future (Indian Express, 2012).

2.2 Significance and benefits of Using Hay Box

- Safe and simple handling – Handling of Hay Box is again simple and is a very safe device.

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- Minimum cooking time- This method of cooking minimum time of boiling and cooking using hay box can be retained for 6 hours.
- Superior quality food- items prepared in this device will have superior quality in flavour, colour, texture, taste- when compared to foods cooked by other methods.
- Gives satisfaction-This technology is found to reduce physical and mental work load of women and provides a lot of satisfaction with family.
- Merge nutrient loss. As the cooking medium is completely absorbed by the food material, the nutrient loss is minimum.
- Saves resources- this technology helps to save fuel, money, labour and time and prevents health hazards (Ambrose Health, 1956).

2.2.1 Cost Benefit Analysis

In Gas stove (cooking time 2 hrs a day) in Hay Box (cooking time 1 hr a day).
Fuel charge spent for a day-Rs.5 Fuel charge spent for a day- Rs.2.5. Fuel charge spent for 2 months rs. 300/- Fuel charge spent for 2 months-Rs. 150. Therefore approximately 50% of the fuel and fuel charge can be saved (Topeka, 1908).

2.2.2 Maintenance

The maintenance of the hay box does not cost much, since all that is required is keeping the hay clean without getting soiled by soot or cooked foods. Drying of hay in the sun for an hour or two every fortnight (Topeka, 1908).

2.3 Hay Box Designing, Construction and Advantages

A large wooden box of 60cm x 40cm x 35cm or any other convenient size available was used for this purpose. The box filled with hay forms a hay box. Prepare a pillow of cotton almost the size of the box and fill up with hay and fill up with hay which will work as a perfectly insulated box. When a good foundation has been made. Four pillows for the four sides and two for the bottom and top was made. This should be filled with hay tightly. The box was made ready. A suitable vessel or vessels preferably without long handles should be selected. The pot of pre boiled food will be placed firmly in the box.

Take any food item you wish to cook like rice, dal, wash and clean it up. For rice and khichidi, just double the amount of water required for the item to be cooked. In order to cook rice, boil the required amount of water separately.

When water starts boiling, add the rice and a pinch of salt and cover it. After four minutes remove the utensil from the fire and make space for it in the hay box and put the utensil. Keep the lid of the utensil closely tight, otherwise the steam will

pass out and the item will remain uncooked. After putting the utensil in the hay box, place the pillow over it and shut the box. It takes 15 minutes for vegetables, 30 minutes for rice and about 1 hour for dhal to cook.

This method is very useful for cooking rice, porridge, and anything requiring slow cooking. A hay box is most useful when gas is used for cooking as it will continue to cook things otherwise requiring a small gas to keep them going. It saves fuels as no fuel is required in the hay box. The food remains warm for 5 to 6 hours. There are no chances of burning and ‘over boiling’ of the food.

This method is very useful for cooking rice, porridge and anything requiring slow cooking. Hay box is almost useful when gas is used for cooking as it will continue to cook things otherwise requiring a small gas to keep them going. It saves fuel as no fuel is requiring in the hay box. The food remains warm for 5 to 6 hours. There are no chances of burning and boiling over of the food (Varghese, 2005).

Principles to be kept in mind while cooking in solar cooking

- Insulation should cover all six sides of the box.
- The box should be airtight.
- The inner surface of the box should be heat-reflective material (Davis, 1914).

There are some adjustments involved in cooking with Hay Box Cookers:

- Less water should be used since it is not boiled away.
- Less spice is needed since the aroma is not boiled away.
- Cooking must be started earlier to give the food enough time to cook at a lower temperature than on the solar cooker or over fire.
- The food should boil for several minutes before being placed in the box. This ensures that all the food is at boiling temperature, not just the water.
- Hay box cookers work best for large quantities, as small amounts of food have less thermal mass and cool pre heated stones could always be put together with the pot to provide the additional thermal mass needed to keep the temperature up over a long period of time (Davis, 1914).

2.3.1 Advantage of Using a Hay Box

Hay box (also called retained- heat cooking) is an age-old method that can be used to conserve energy not only during times of crisis, but anytime. Depending on the food item and amount cooked, the use of a Hay Box or insulated cooker saves between 20% and 80% of the energy normally needed to cook a food. The longer an item usually takes on a stovetop, the more fuel is saved. For example, with Hay box, five pots of long-cooking dry beans will use the same amount of fuel to cook to completion as just one pot cooked without a hay box (Hildbeith, 1989).

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The principle of retained-heat cooking is simple. In conventional cooking, any heat applied to the pot after it reaches boiling temperature is merely replacing heat lost to the air by the pot. In hay box cooking, food is brought to a boil, simmered for few minutes depending on the particle size(5 minutes for rice or other grains, 15 minutes for large dry beans or whole potatoes), then put into the hay box to continue cooking. Since the insulated cooker prevents most of the heat in the food from escaping into the environment, no additional energy is needed to complete the cooking process. The hay boxed food normally cooks within one to two times the normal stovetop cooking time. It can be left in the hay box until ready to serve, and stays hot for hours. “Timing” is much less important than in stovetop cooking: stick a pot of rice, beans, or stew in at lunch time, and it will be ready when you are, and steaming hot, at dinner time (Hildbeith, 1989).

The hay box itself is any kind of insulated container that can withstand cooking temperatures and fits relatively snugly around the pot. Hay boxes have been made using hay, straw, wool, feathers, cotton, rice hulls, cardboard, aluminium foil, newspaper, fibre glass, fur, rigid foam, and/ or other suitable materials as insulation. The insulation is placed between the rigid walls of a box, within a double bag of material, or lining a hole in the ground. “Instant hay boxes” have been created by wrapping a sleeping bag, blankets, and / or pillows around a pot. The most effective insulating materials create many separate pockets of air, which slow down the

movement of heat. 2 to 4 inches of thickness (depending foil on the material) are necessary for good insulation. Some materials, such as aluminium foil actually reflect heat back toward the pot (Hildbeith, 1989).

2.3.2 Cooking Time for Different Food items

Table 1

Cooking Time for Different Food items in Hay box

Food	Boil time	Hay box time
Rice	5 min	1-1.5 hours
Potatoes	5 min	1-2 h
Soup and stock	10 min	2-3 h
Green lentils	10 min	3-4 h
Pintos	10 min	3 h
Split peas	10 min	2 h
Quinoa	5 min	1.5 h
Millet	5 min	1 h
Polenta	1 min	1 h
Winter squash	5 min	1-2 h
Steamed bread	30 min	3 h
Chicken	6 min	2-3 h
Beef	13 min	3-4 h

(Martin, 1975).

2.4 Other Ideas of Developing Hay Box

One couple have made a Hay box completely from items they have picked up from time to time. It consists of two wooden boxes one fitted into the other. The floor of the larger box has been layered with sawdust, pieces of paper, rags and hay to a depth of 7 cm and with the smaller box inserted; these materials are stuffed into the gap between the two boxes thus insulating it very well. On the inside of the smaller box there is a layer of small cushions made simply from colourful pieces of cloth or flannel stuffed with insulating materials into which the hot pot is placed and some more bolsters and cushions are placed on the top of this to complete the insulation (Martin, 1975).

Prior to making their Hay Box they had utilised the same principles in a simpler method. They would bring the pot to the boil and then put it in bed and wrap it in blankets, thus insulating the pot and continuing the cooking process. They didn't say if the pot was ever disturbed by one of their children jumping on the bed (Binnie and Boxali, 1954).

In the book Binnie and Boxall suggested that you make it from a large sugar box lined with brown paper or newspaper, then packed very tightly with hay. He advises using any remaining space by making a thick pad of hay enclosed in a piece of flannel or a old pillow case. "A Hay Box is most useful when gas is used

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for cooking, as it will continue to cook things otherwise requiring a small gas to keep them going” (Binnie and Boxali, 1954).

Em.Hildbeith’s Hay Box consists of 4” insulation against each of the walls of the rectangular box ‘lined with newspapers--. at least 8 layers covered with brown paper and held in place with American cloth fixed by tacks or glue. The cushions taking up any remaining space were old blankets and cloth stuffed with hay (Hildbeith, 1989).

Polyestylene, as we used it earlier was in sheets. It is available in beads also and if you make a pillow as illustrated and fill it with beads and hay you will have an effective pliable cooker that might double as a sag bag if made with a little foresight. A quilt shape to fit the pot as illustrated and filled with fibreglass, har or polystyrene beads will also produce good results and have the advantage of being able to be folded up and moved about easily (Hildbeith, 1989).

2. METHODOLOGY

Methodology is the procedure of research technique. Research methodology is a way to systematically show the research problems. It may be understood as a science of studying how research is done scientifically (Kothari 2013).

The methodology pertaining the study “Development of education module on eco friendly energy conservation indigenous equipment- hay box” was conducted

3.1 Designing and construction of hay box

3.2 Comparison of cooking time in hay box and open cooking using LPG

3.3 Sensory evaluation of cooked food using score card

3.4 Development of education module

3.5 Education class for women and college students

3.6 Evaluation

3.1 Designing and construction of hay box

The hay box was designed and constructed. The materials used for the construction is hay, wooden box, and cotton cloth for making insulating pillows.

A large wooden box of 40 cm x 40 cm x 40 cm was constructed with the help of carpenters. A model box was prepared using hardboard. The preliminary pilot study was conducted using this hay box. Later on wooden boxes were made by carpenters. Cushion covers of cotton was made. Fill the cushion covers with hay which will work as a perfectly insulated box. Six cushions were made for each boxes. One for top and bottom, four cushions to cover the four sides of box. The hay should be filled tightly. The box was made ready. A suitable vessel or vessels preferably without long handles should be selected. The pot of pre-boiled food will be placed firmly in the box.

3.2 Comparison of cooking time in hay box and open cooking using LPG

Procedure of cooking using hay box

Some selected food items were cooked using following two methods:

- **Open cooking method exclusively on LPG**
- **Cooking using LPG gas and in hay box.**

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The food stuffs cooked were Rice, Dhal, Potato, Beans, Chicken and fish. The time taken for the food to be cooked was recorded and compared. The heat retention inside hay box was also recorded.

Take any food item to cook like rice, dal, wash and clean it up. For rice and khichidi, just double the amount of water required for the item to be cooked. In order to cook rice, boil the required amount of water separately. When water starts boiling, add the rice and a pinch of salt and cover it. After four minutes remove the utensil from the fire and make space for it in the hay box and transfer the covered utensil to the hay box immediately. Keep the lid of the utensil closely tight, otherwise the steam will pass out and the item will remain uncooked. After putting the utensil in the hay box, place the pillow over it and shut the box. The time was recorded. The cooked item was subjected to sensory evaluation.

3.3 Sensory evaluation of cooked food using score card

The food prepared through Hay Box cooking methods were subjected to sensory evaluation. A panel of judges were selected and score card with parameters like colour, texture, flavor, taste, and overall appearance was formulated. The structural score card was given to the panel members.

The panel members were allotted with a comfortable position to evaluate the recipes. The score card with respect to each parameters was recorded in the

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score card (Appendix-3) and assessed using rating scales. (A rating scale is a set of categories designed to elicit information about a quantitative or a qualitative attribute).

3.3.1 Recording heat retention

Each food items heat retention was recorded using thermometer. Initial temperature was recorded for all items. The temperature was recorded every two hours for all the food items.

3.4 Development of education module

In order to educate the people an education module was developed to teach about the designing and construction of hay box (Appendix-4). The education module entitled “Energy saving Hay box” was published with ISBN No: 9788172550691. The booklet was made for common people hence care was taken to use simple phrases which is easy to understand. The sections covered was types of hay box, principle of cooking, procedure for construction, materials and alternative materials used, procedure for cooking, benefits, comparison of cooking time, heat retention and maintenance was also included.

Educational video (Appendix-5) was also developed detailing the materials used, principle involved, procedure and benefits of hay box. This also gives an idea to construct hay box.

3.5 Education class for women and college students

Several classes were conducted in different areas of Ernakulam and Thrissur Districts. Classes were conducted for different categories of the community (Appendix-6)

- Adult women –Through Kudumbasree of Cherai, Moothakunnam, Karukutty and Champanoor
- College Students
- School students
- Public through exhibition conducted in college

A class was given for – UG students of Morning Star Home Science College Angamaly and hostel, – women of Angamaly about the designing, construction of hay box and how it conserve energy.

The class was about the designing, construction of hay box and how it conserves energy. Cooking using hay box was also done on the spot. This helped the women to check the heat retention. Twenty four hay boxes were distributed to the interested people on first come first serve basis.

3.6 Evaluation

To assess the awareness regarding hay box, a pre-test (Appendix-1) and post-test questionnaire (Appendix-2) was designed by the researcher. The pre test questionnaire was distributed to the subjects ten minutes before the education class. The post test questionnaire was also distributed after the education class. The filled in forms was collected back.

4. RESULTS AND DISCUSSION

The results pertaining to “**Development of education module on eco friendly energy conservation indigenous equipment- hay box**” was carried out in different stages. The study was conducted among women of rural areas. The results of the study are discussed under the following heads:

4.1 Cooking time for different food stuffs

4.2 Sensory evaluation of cooked items

4.3 Techniques used for fuel conservation

4.4 Effectiveness of education class- based on pre test and post test

4.1 Cooking time for different food stuffs

Table 2
Comparison of boiling time

Sl.no	Food item	Boiling time on LPG	
		Hay box cooking (in minutes)	Open cooking (in minutes)
1	Rice	5	60
2	Dhal	5	25
3	Potato	5	25
4	Beans	5	20
5	Chicken	7	75
6	Fish	5	20

The above table includes the details about the comparison of cooking time in both Hay Box cooking and gas stove cooking. In Hay Box for cooking, Chicken was boiled up to 7 minutes before keeping in Hay Box and for the remaining food items dhal, potato, beans and fish were boiled only for five minutes before keeping into the Hay Box. In the case of open cooking the rice was boiled up to 60 minutes in gas stove, dhal ,potato were kept up to 25

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minutes, fish and beans were kept up to 20 minutes and chicken was kept for 75 minutes to be fully cooked. Reduction in using LPG helps in saving fuel.

Table 3

Temperature retention in hay box cooking*

Temperature	Rice (200 gm)	Dhal (200gm)	Potato (200gm)	Beans (200gm)	Chicken (200gm)
Initial	100	100	100	100	100
After 2 hours	72	66	68	65	61
After 4 hours	61	54	56	54	52
After 6 hours	48	38	39	38	36

*Figures represent temperature in degree Celsius

The above table includes the details of temperature retention in Hay Box cooking, which shows that the initial temperature of all the food items- Rice, Dhal, Potato, Beans, and chicken were 100°C. The temperature for rice after 2 hours was 72°C and for other food items dhal, potato, beans, and chicken it was 66°C, 68°C, 65°C, and 61°C respectively. The temperature retention after 4 hours

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of food items rice, dhal, potato, beans, and chicken were 61°C, 54°C, 56° C, 54° C, and 52° C respectively. The temperature retained after 6 hours for dhal, and beans were 38° C, and other food items rice, dhal, potato and chicken retained heat upto 48° C, 39° C, and 36° C respectively.

Table 4

Temperature Retained By Cooking In Gas Stove

Details	Rice	Dahl	Vegetables
Initial temperature	100	100	100
Temperature after 30 minutes	70	40	40
Temperature after 60 minutes	60	10	10

*Figures represent temperature in degree Celsius

The above table includes the details of temperature retained by cooking in gas stove in which shows that the initial temperature of all the food items (Rice, Dahl, Vegetables) is 100 degree Celsius. The temperature for rice after 30 minutes is 70 degree Celsius and for dhal and vegetables it is 40 degree Celsius .And the

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temperature for rice after 60 minutes is 60 degree Celsius, for dhal and vegetables it is 10 degree Celsius.

4.2 Sensory evaluation of cooked items

Table 5

Score card for boiled rice

Parameters	Judges					Average
	1	2	3	4	5	
Appearance	4	5	4	4	5	4.4
Colour	4	5	5	4	4	4.4
Texture	3	4	4	4	4	3.8
Flavour	4	4	5	4	5	4.4
Taste	3	4	4	4	5	4
Overall appearance	3	4	4	4	5	4

The above sensory evaluation score card shows that the boiled rice was having a good texture and the other remaining parameters like appearance, colour, flavour. While taste and overall appearance were 4. The rating was done using the rating scale (appendix-1) The average score was 4.16.

Table 6

Score card for dhal

Parameters	Judges					Average
	1	2	3	4	5	
Appearance	4	4	5	5	4	4.4
Colour	4	5	4	4	4	4.2
Texture	4	4	5	5	4	4.4
Flavour	5	5	4	4	4	4.4
Taste	5	4	5	5	5	4.8
Overall appearance	4	4	5	5	4	4.4

The above sensory evaluation score card shows that the cooked dhal had very good appearance, colour, texture, flavour, and overall appearance and among all parameters taste scored the highest. This rating was done using rating scale (appendix-1) The average score was 4.43.

Table 7

Score card for beans

Parameters	Judges					Average
	1	2	3	4	5	
Appearance	5	4	4	4	4	4.2
Colour	5	4	4	5	4	4.4
Texture	4	4	4	4	4	4
Flavour	4	5	5	4	4	4.4
Taste	4	4	4	4	4	4
Overall appearance	4	4	4	4	4	4

The above sensory evaluation shows that the cooked beans was having a very good appearance colour, texture, flavour, taste, and overall appearance. This rating was done using rating scale (appendix-1).The average score was 4.16.

Table 8
Score card for potato

Parameters	Judges					Average
	1	2	3	4	5	
Appearance	5	5	5	5	5	5
Colour	5	4	5	5	5	4.8
Texture	4	4	4	5	5	4.4
Flavour	4	5	5	4	5	4.6
Taste	4	5	5	5	5	4.8
Overall appearance	4	5	5	5	5	4.8

The above sensory evaluation score card shows that the cooked potato was having an excellent appearance and other parameters like colour, texture, flavour,

taste, and overall appearance were very good. This rating was also done using rating scale. The average score was 4.73

Table 9

Score card for chicken

Parameters	Judges					Average
	1	2	3	4	5	
Appearance	5	5	5	5	5	5
Colour	5	4	5	5	4	4.6
Texture	3	4	5	5	4	4.2
Flavour	4	4	4	4	5	4.2
Taste	3	3	4	4	5	3.8
Overall appearance	4	4	5	4	5	4.4

The above sensory evaluation score for cooked chicken shows that appearance was excellent and taste was good and the remaining parameters like

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colour, texture, flavour and overall appearance was very good. This rating was done using rating scale. The average score-4.36

Table 10
Average scores on sensory evaluation

Parameters	Average scores				
	Rice	dhal	Beans	Potato	Chicken
Appearance	4.4	4.4	4.2	5	5
Colour	4.4	4.2	4.4	4.8	4.6
Texture	3.8	4.4	4	4.4	4.2
Flavour	4.4	4.4	4.4	4.6	4.2
Taste	4	4.8	4	4.8	3.8
Overall appearance	4	4.4	4	4.8	4.4

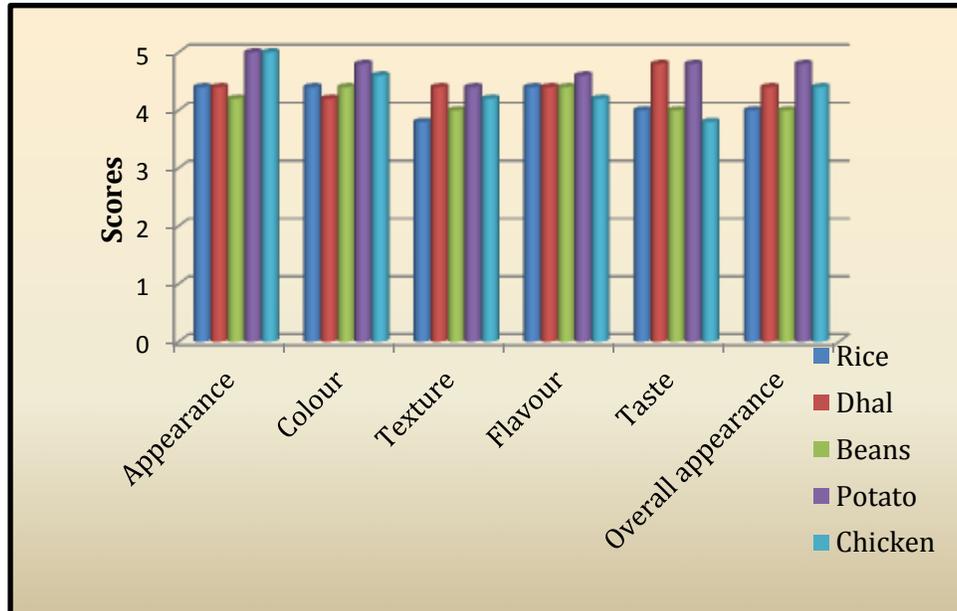


Figure 1

Scores of sensory evaluation

The above table and figure shows the average scores obtained in sensory evaluations of rice, dhal, beans, potato and chicken. Potato scored highest in comparison to all other food products which were a part of this sensory evaluation.

4.3 Techniques used for fuel conservation

Table 11

Techniques used for fuel conservation

Techniques*	Frequency (n=100)
Use Biogas	18
Use low flame when boils	88
Cooks more quantity at a time	6
Close the vessel while cooking	80
Getting ready before starting preparation	4
Any other	58
Uses small vessels	10
One time cooking	24

***Multiple choice questions**

According to the above mentioned table in order to conserve energy, 88.0% people used low flame after boiling. 80 percent participants used closed vessel while cooking in order to conserve energy. All the other option were less frequently opted by the respondents.

4.4 Effectiveness of education class- based on pre test and post test

Table 12

Awareness regarding hay box

Details	Pre-test (n=100)		Post test (n=100)	
	Aware	Unaware	Aware	Unaware
Purpose of hay box	36	64	100	Nil
hay box cooking is nutritious	40	60	100	Nil
Unequal cooking time for different food	42	58	100	Nil
Hay box saves time and money	41	59	100	Nil

The above displayed table denotes that success of the educational session conducted regarding the awareness of hay box, its uses, advantages etc among the participants. During the pre-test phase only 36 participants were aware about the

purpose of a hay box. Only 41 were aware of the time and money saving factor regarding hay box. 60 participants didn't even know that hay box cooking is nutritious. 58 people weren't even aware of time consumption for various foods. After the session there wasn't a single person who didn't understand the concept and benefits of this energy saving method.

Table 13

Awareness regarding types of materials used

Types of materials	Pre-test (n=100)	Post test (n=100)
	Aware	Unaware
Hay	52	100
Plastic	Nil	Nil
Paper	Nil	Nil
Don't know	48	Nil

From the above table we can perceive that the awareness regarding the materials used for filling a hay box was a little in pre-test. After the session, post

test results were amazing that everyone were aware about the filling materials used.

Table 14

Alternative filling materials used

Materials	Pre test (n=100)	Post test (n=100)
Paddy husk	7	Nil
Wood	5	Nil
Hay	8	Nil
Woollen cloth pieces	3	Nil
All above	8	100
Don't know	69	Nil

From the above table we can see that only a small percentage of the participants were aware about alternative filling materials such as paddy husk, Wood, Hay, Woollen cloth pieces, all three, before pre-test. After the post test the awareness was complete among the subjects.

Table 15

Advantages of hay box

Advantages*	Pre-test (n=100)	Post-test (n=100)
Low cost	26	12
Made with locally available materials	17	Nil
Less fuel consumption	10	6
Easy to maintain	Nil	Nil
No supervision is needed	Nil	Nil
No reheating is needed	6	Nil
Conserve energy	Nil	Nil
All above	24	82
Don't know	75	Nil

***Multiple choice questions**

According to the above table we can see that the awareness about the advantages of hay box was very scarce among the subjects during the pre-test.

Only the low cost benefit was known to 26 subjects which is the best score among the advantage traits of a hay box. After the session and post test the results were really good.

Table 16

Awareness regarding boiling time for rice

Time	Pre-test (n=100)	Post test (n=100)
5 minutes	10	85
10 minutes	Nil	Nil
15 minutes	8	Nil
Varies with content	82	15

The above table shows people's awareness about the boiling time for rice before keeping in hay box. On the pre-test phase 82 people said that time may vary according to content, 10 said it will be around 5 minutes and 8 participants

opined it was around 15 minutes. After the session and post-test 85 went with 5 minutes and only 15 thought that it may vary with content.

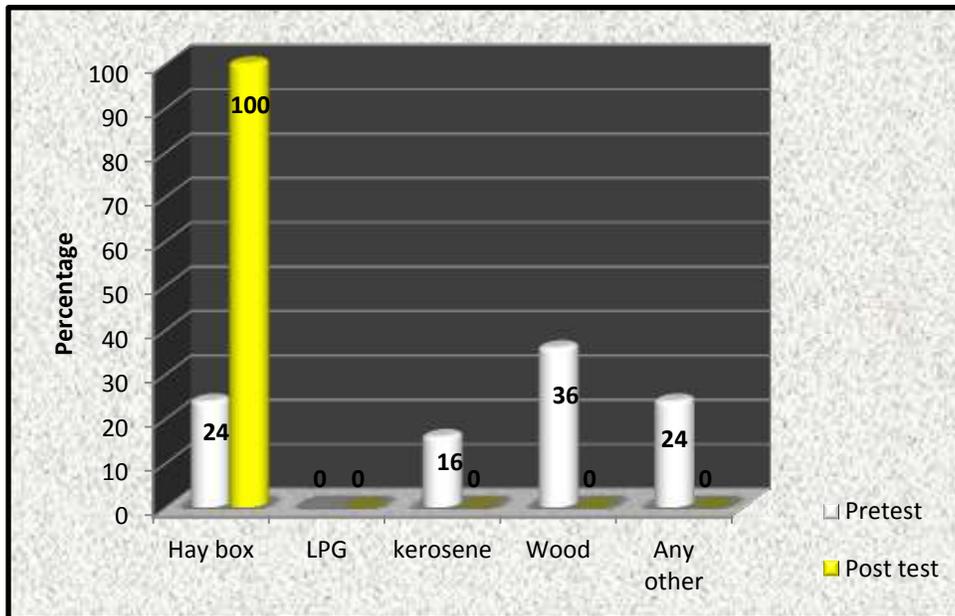


Figure 2

Opinion regarding cost effective cooking method

From the above given graph we may presume that a majority of people shared an opinion that wood is the most cost effective cooking method on the pre-test evaluation. Hay box had only the third place and no one considered LPG as one. After the session and post test all without any opposition chose hay box as the most cost effective method of cooking.

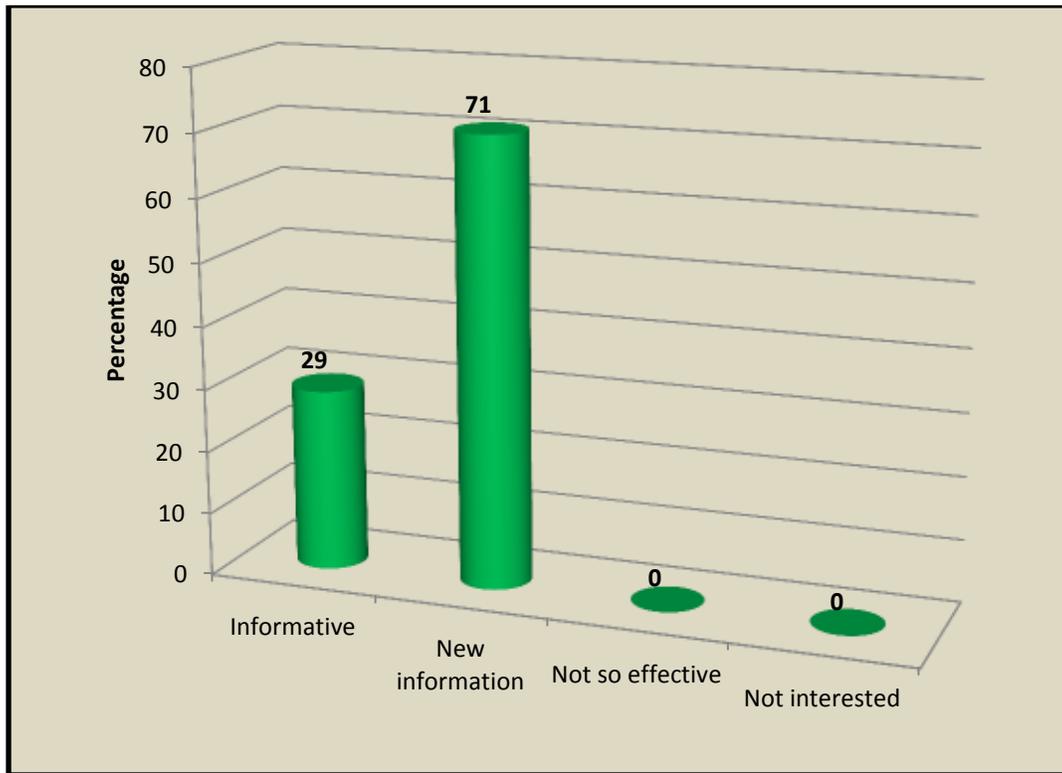


Figure 3

Opinion regarding class

From the above given graph we can assume that the entire educational session was informative to all participants. While 29 people among the participants agreed on that the entire session was informative, the rest of the participants, i.e., 71 people asserted on the session that it was not only informative but also contained a lot of new information.

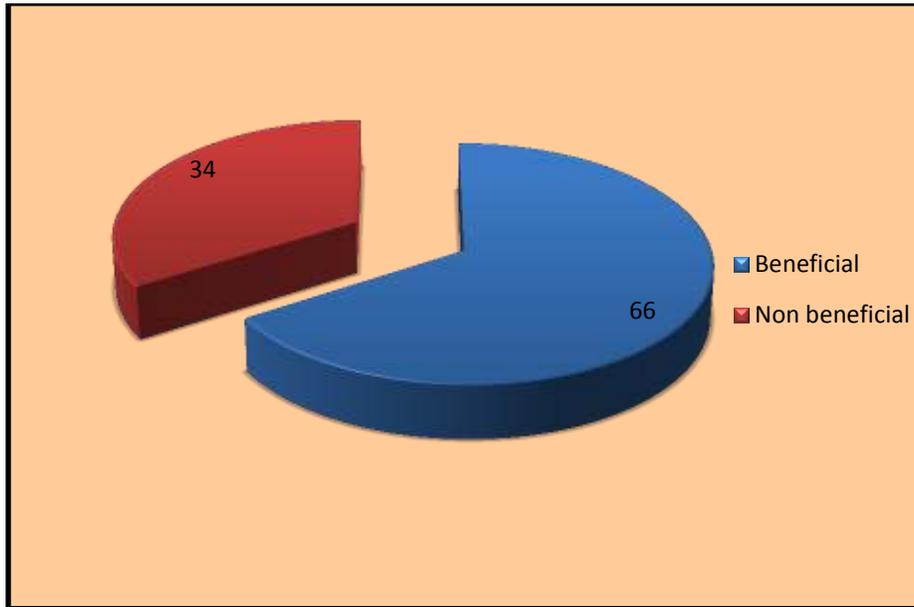


Figure 4

Opinion regarding benefits

After the entire session 34 participants among the 100 had an opinion that hay box is not that beneficial as another cooking methods. But 66 subjects found that hay box is indeed a beneficial cooking method that can be adapted during this difficult time of energy consumption scarcity.

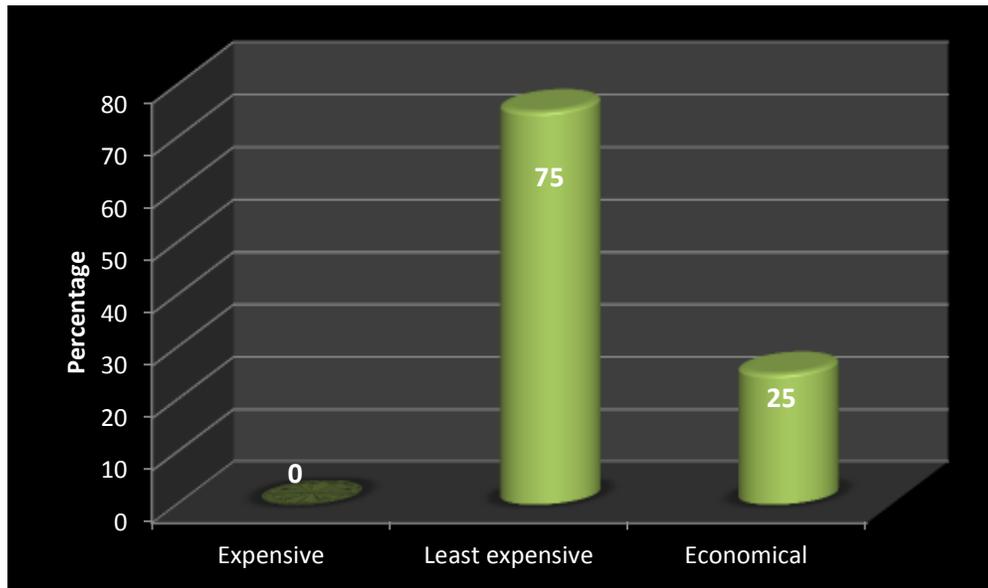


Figure 5

Opinion regarding cost of Hay Box

According to the above depicted figure any of the participants in the post test after the educational session didn't consider hay box as an expensive cooking method. 75 participants found it as a least expensive cooking method while 25 considered this hay box method of cooking economical.

5. SUMMARY AND CONCLUSION

The project entitled “Development of Education Module on Eco friendly Energy Conservation Indigenous Equipment- Hay Box” was conducted through different stages:

- Designing, constructing and cooking in Hay Box
- Cooking different food stuffs using hay box and open boiling.
- Comparing the cooking time in gas stove for both methods
- Sensory evaluation was also done for the food cooked in Hay Box.
- A booklet was prepared for educating people.
- Hay box was demonstrated in exhibitions
- Classes were conducted in different areas.
- Effectiveness of class was measured using pre-test and post-test questionnaire

The major findings of the study are as follows:-

- Cooking exclusively on LPG uses more fuel, while when it comes to hay box cooking combined with LPG needs only 5-7 minutes LPG fuel for cooking. Rest of the heat required for cooking is obtained from the retained heat.

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- Heat retention is more in hay box- food stays hot for longer period. Hence reheating is not needed and prevents the nutrient loss by reheating.
- Sensory evaluation of cooked food also shows good scores for all food cooked in hay box
- Sensory evaluation of cooked rice -The average score is 4.16.
- Sensory evaluation of cooked dhal- The average score was 4.43.
- Sensory evaluation of cooked beans- The average score was 4.16.
- Sensory evaluation of cooked Potato- The average score was 4.73
- Sensory evaluation of cooked Chicken- The average score was 4.36
- Techniques used for conservation includes Use low flame when boils, Close the vessel while cooking. Other techniques were not mostly opted.
- All of them agreed hay box is the cost effective method.
- Classes were found to be informative. For 71 percent it was new information.
- Opinion regarding cost- it was least expensive.

Conclusion

The study can be concluded as the food cooked in the Hay Box was nutritious and fuel consumption in Hay Box was very less when compared to Gas cooking. And construction of hay box can done with locally available

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materials like hay and paper. So it is a low cost and fuel saving cooking method which can be adopted by the homemakers.

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APPENDICES

APPENDIX-1

PRE TEST- QUESTIONNAIRE

1. Do you know the purpose of a hay box?
yes no
2. What type of materials are commonly used in filling of hay box?
Hay paper plastic
3. Is the boiling time of food items placed in the hay box are same for all?
yes No
4. According to you which type cooking is cost effective?
Hay box cooking Gas cooking
5. Do you think cooking in hay box is much difficult than cooking in stove?
Yes No
6. Is the time taken for cooking inside the hay box are same for every food items?
Yes No
7. Do you think much skill is required to cook in the hay box?
Yes No
8. What makes hay box different from other heat retaining modern equipments?

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Low cost Can be made with locally available materials

Less fuel consumption Easy to maintain All above

9. Do you think hay box saves nutrients of food while cooking?

Yes No

10. Do you think hay box saves time and money?

Yes No

11. What are the advantages of hay box do you think?

a. Cost of construction is less

b. It can b constructed with locally available materials

c. Ease in handling and maintenance

d. No supervision is needed

e. No reheating is needed

f. Conserves energy

g. All above

12. What is the boiling time required for the rice before keeping in the hay box?

Five minutes Ten minutes Fifteen minutes

13. What are other materials used to insulate the hay box?

Paddy husk Wood wool woollen cloth pieces

Paper All above

14. Methods adopted for fuel conservation

Use bio gas Use both LPG, wood and kerosene

use low flame when it boils uses small vessels

- Cooks more quantity at a time One time cooking
 Close the vessel while cooking Getting ready before starting
preparation

APPENDIX-2

POST TEST QUESTIONNAIRE

15. Do you know the purpose of a hay box?
yes no
16. What type of materials are commonly used in filling of hay box?
Hay paper plastic
17. Is the boiling time of food items placed in the hay box are same for all?
yes No
18. According to you which type of cooking is cost effective?
Hay box LPG Kerosene Wood Any other
19. Is the time taken for cooking inside the hay box are same for every food items?
Yes No
20. Do you think much skill is required to cook in the hay box?
Yes No
21. What makes hay box different from other heat retaining modern equipments?

Development of education module on eco friendly Energy conservation indigenous equipment-Hay Box

Low cost Can be made with locally available materials

Less fuel consumption Easy to maintain All above

22. Do you think hay box conserve nutrients of food while cooking?

Yes No

23. Do you think hay box saves time and money?

Yes No

24. What are the advantages of hay box do you think?

h. Cost of construction is less

i. It can b constructed with locally available materials

j. Ease in handling and maintenance

k. No supervision is needed

l. No reheating is needed

m. Conserves energy

n. All above

25. What is the boiling time required for the rice before keeping in the hay box?

Five minutes Ten minutes Fifteen minutes

varies with contents

26. What are other materials used to insulate the hay box?

Paddy husk Wood Hay woolen cloth pieces

Paper All above

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27. Did you gain information from the class?

Informative new information not so effective
not interested

28. Are you going to use this information?

Yes No

29. Will you use hay box for your cooking?

Yes No

30. Have you ever heard of benefits of having hay box before this class?

Yes No

31. What types of cooking can be done using hay box

All types boiling steaming frying

32. Will your recommend hay box to others?

Yes No

33. What about expense in constructing hay box?

Expensive least expensive economical

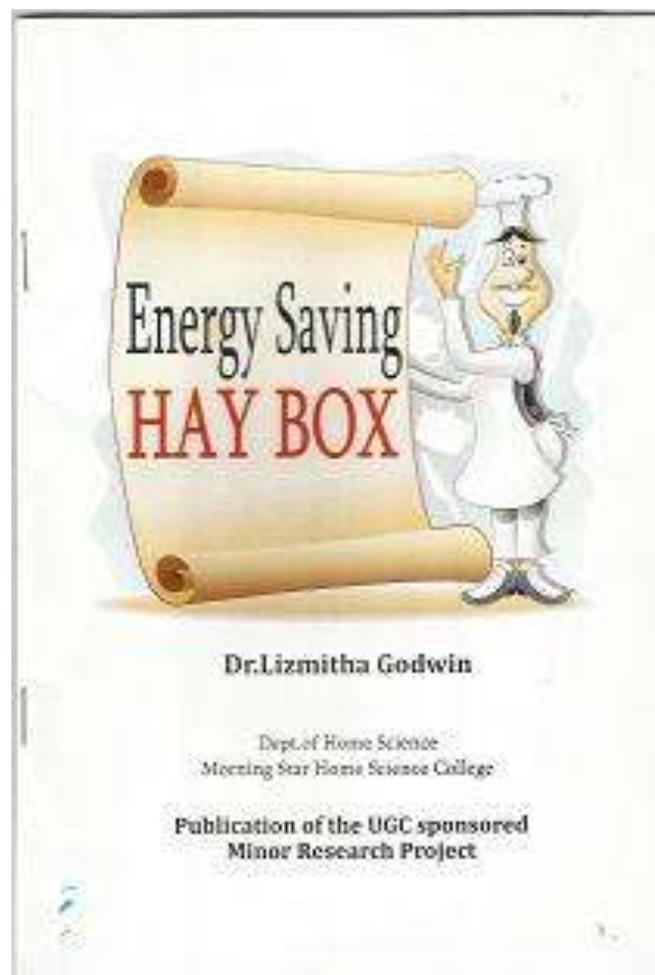
APPENDIX-3

SCORE CARD

Parameters	Judges					Average score
Appearance						
Colour						
Texture						
Flavour						
Taste						
Overall appearance						

APPENDIX -4

EDUCATION MODULE-BOOKLET



APPENDIX -5

VIDEO FOR EDUCATION (attached with hard copy)

APPENDIX-6

GLIMPSES OF EDUCATION PROGRAMME

Glimpses of education class



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Filling questionnaires



Glimpses of community classes



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