Performance Study of 'Avinash' Model Solar Box Cooker

By

Sumathi .A .P

A DISSERTATION SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN-DEEMED UNIVERSITY, COIMBATORE - 641 043

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF **MASTER OF SCIENCE IN FAMILY RESOURCE MANAGEMENT**

May 1999

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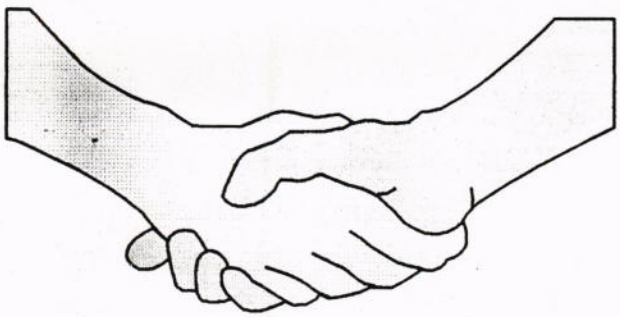
Certified as Bonafide Research Work

Signature of the
Head of the Department

Signature of the Guide



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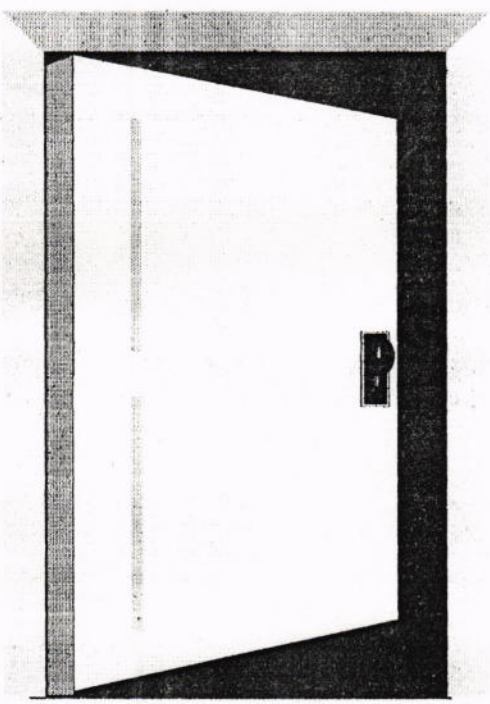


INTRODUCTION

I INTRODUCTION

"The time has come when greater emphasis should be laid on deriving energy from the sun, wind and water...we must now make urgent all our scientific efforts to promote the development and utilization of renewable energy to reduce our dependence on fossil fuels and to help safe guard our environment."

- Shrimathi. Indira Gandhi.

Energy is a vital input for economic and social development with increasing industrial and agricultural activities, energy is recognised as an index of country's development on the basis of the per capita consumption of energy in the rural and urban households (Devadas 1997, Rai 1992 and Jadhav 1997,). It is a critical and basic commodity which supports life on earth (Parvathi and Chandrakandhan, 1995). It is the life blood of man's life and productive activities (Srilatha, 1995). Human life is dependent on the constant expenditure and conservation of energy (Sharma and Wadnawan, 1991). Energy improves the standard of living and life activities would come to a halt in the absence of energy resources (Arokiasamy, 1981 and Neelkanth, 1991).

The present energy scenario, both consumption and demand shows that both developed and developing nations face a severe energy crisis. This energy crisis is mainly due to the fast depletion of fossil fuels, increased prices of energy resources, rise in population and increased per capita income (Jayaraman, 1990). Agarwal (1983)

opines that if present trend continues, the world in the year 2000 A.D. will be more crowded, more polluted than that of today and nearly 250 millions additional people will be without fuel for cooking and heating and they will be forced to use non-commercial energy sources (Parvathi et al., 1995).

The recent report of the UN Food Agricultural Organisation, 1995 clearly projects that "Over 1.5 billion people are affected by firewood shortages and the number will grow to 2.4 billion by the year 2000". It was found that firewood accounts for over 80 per cent of the total energy resources in the villages and that of 96 per cent of this resource was consumed domestically, 82 per cent for cooking and 14 per cent for heating water. Cooking accounted for 2.48 human hours on an average per day to this, thus the rural women is more affected by the energy crisis (Mathur, 1988, Ramakrishnan, 1992 and Pachauri, 1999).

Energy crisis has forced scientists and technologists to search for efficient and appropriate technology, utilizing renewable sources of energy. In this context, solar energy is an inexhaustible, pollution free, almost costless source, which has unlimited scope in tropical sunny countries like India. Devadas (1980), Meena (1982) and Bose (1983) have rightly said that India being a tropical country lying near the equator, between 7°N and 37°N receives a large amount of solar energy over many parts of the country. In fact the sunshine is available for over 250-300 days which works out to be 2000 hours-3200 hours per year. The level of both global and diffuse radiation

varies from 1600-2200 Kwh/m^2 per month and 60-180 Kwh/m^2 per month during winter. The total solar radiation varies from 5-7 Kwh/m^2 per day in sunny regions (Gusain, 1990).

Srivastava (1992) quantified that the total energy received by the whole land of India to be about 19 trillion kilowatt hour per day and India is blessed with solar energy. "Solar energy is the energy of the future not just an alternative" was the message at the recent world solar energy conference. This energy will soon achieve great economic importance.... Not only in third world countries which lack their own primary energy resources such as coal, gas and oil but also in the industrialized countries (Hindu, 1988).

Solar energy is time dependent and intermittent source of energy available plentiful in tropical countries. India has an abundance of solar energy but ironically is in the grip of severe energy crisis. Basically solar energy is constant, ever renewable, non-polluting in nature and available in all parts of the country. Solar energy which is readily available with an average intensity of 450 cal/ sq.cm./day in India at free of cost has been identified as one of the most significant non conventional sources of energy (Lal, 1988 and Mann, 1992).

Solar energy received in the form of radiation can be converted directly or indirectly into other forms of energy such as heat and electricity which can be utilised by man. Since the sun is expected to radiate at an essentially constant rate for a few billion years, it may be

regarded as an inexhaustible source of useful energy (Glasstone, 1983, Singh and Prabhakar, 1994).

Solar energy would be the best and ready alternative to domestic fuels if harnessed through solar cooking devices. Solar cooker is a viable and promising technology for cooking food which is likely to help meeting the future domestic needs. It is a new kind of cooking – a free gift of nature. As solar cooker works only on solar energy, it keeps the environment clean, maintains the tree cover, prevents the soil erosion and it conserves the precious conventional energy resources of the country (Dayal, 1989 and Stibravy, 1994).

Sharma (1983) views that God hath made man upright, but they have sought out many inventions and the crown is the solar cooker. This device solar cooker that has come to the market promises to become a precious fuel saving gadget. Solar cooker carries the distinction of safety, simplicity, economy and preserving the environment. More over the solar cooker preserves the nutritive value of food as cooking is done on low temperature (Gambhir and Good, 1988). Eventhough it cannot replace the LPG or any other conventional fuel completely, one can affirmatively say that it is an effective supplement which can bring about considerable saving of fuel, money and energy.

Wang (1994) remarks that cooking with sunlight not only benefits people worldwide but also ourself and other generation throughout the ages. Rao (1992) points out that though there is no

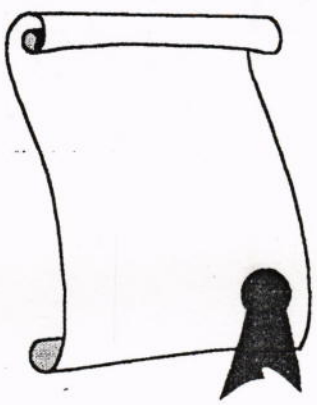
need of fuel to be used in solar cooker for cooking it has not gained popularity in the market mainly it takes long time to cook and solar cooker can only be used for day time cooking.

Consortium of Rural Technology (1993) opines that the factors inhibiting the diffusion of solar cookers are high cost, non availability in the market, heavy weight, difficulties in care and maintenance of the cooker, the socio-cultural habits, lack of awareness on solar cookers and inadequate motivation.

Even though there are many cookers designed by various organisations, people are unaware of the best model in terms of light weight, convenience and efficiency of the cooker. To identify and establish the best model cooker suitable for Indian households which will be available in the local markets, the research on the title "Performance Study of "Avinash" model Solar Box Cooker" is chosen with the following objectives.

1. To Study the performance of "Avinash" model solar box cooker.
2. To Assess the efficiency of the selected Solar cooker and
3. To find out the acceptability of the "Avinash" model solar cooker.

It is hoped that the findings of the study will be of immense help to Indian households to conserve fuel and solve the problem of energy crisis.



REVIEW OF LITERATURE

II REVIEW OF LITERATURE

Review of literature pertaining to the research on " Performance study of 'Avinash' Model Solar Cooker" are discussed under the following headings:

A. Need and Importance of Solar Energy

B. Designs of Solar Box Cookers

C. Prospects and Constrains of Solar Cookers

D. Agencies Promoting Solar Cookers

E. Studies Conducted in Solar Cookers

A. Need and Importance of Solar Energy

The energy that can be obtained in the form of heat and power from the sun's radiation is called as "Solar Energy"(Thangavel, 1992). Chandra (1988) points out that the increasing demand for energy, escalating oil prices, fast depletion of fossil fuels, unchecked deforestation and exponential population growth have directed the attention of scientists, technologists, economists and administrators to concentrate on developing alternate energy resources that are low cost and pollution free.

Therefore modern science and technology have to concentrate for conservation of energy bearing materials by exploring alternative and utilising them efficiently. Solar energy is the main source through which life is sustain on earth. In the wake of energy crisis, therefore solar energy seems to be the most promising source to meet the requirements (Devadas and Muthu, 1992).

Energy development will have to follow a safe environmentally sound and economically viable pathway that will sustain human progress in the long term future giving a fair and equitable share to the under priviledged and poor of the developing countries (Narayanan, 1998).

Environmental problems are created at each stage of production, upgrading transportation and utilisation of fuels. For example, acid water drainage from cold mines, air and water pollution from electricity generating plants present serious environmental problems (Boparai, 1998).But solar energy has permanence as well as non polluting nature. That is why the world prefers solar energy as their energy for the future (Devaraj, 1993 and Karthikeyan, 1996).

Sunilnegi (1995) opines that solar energy is considered as a major source to meet India's energy needs. It has the following three attractive important characteristics, the sun is essentially an infinite source of energy. It is available to all national and immune to political control and this energy can be harnessed with maximum detrimental effects on the environment (Mohan, 1998).

Sarabhai (1985) states that much of the world's energy demands could be met by solar energy which is abundant and in the long run economical too. The ultimate source of energy is the sun and there are parts of the world which are better suited for solar energy conversion than others (Subramaniam,1983 and Strains and Mainwaring ,1984)

B. Designs of Solar Cookers

Different solar cooker designs are given below.

1. Box type solar cooker (Kuhnke Klaus et al., 1990)

This box type solar cooker was developed by Central Arid zone Research Institute, Jodhpur. It is a simple cooker suitable for cooking rice, potatoes, pulses, vegetables, etc., The cooker comprises of a double walled box with fibre glass insulation between the walls. The outer wall made of 12.5mm thick teak wood and the inner wall is of blackened 20 gauge galvanised iron sheet. The top of the box contains two clear window glasses placed 50mm apart in an airtight frame. For the protection of glass parts and also for reflection of solar radiation a wooden cover with a mirror fixed on its inner face is used. The angle between the wooden cover and the clear window glass can be adjusted to the desired value. Castor wheels are provided for movement of the cooker. In this cooker direct radiation reflected by the mirror.

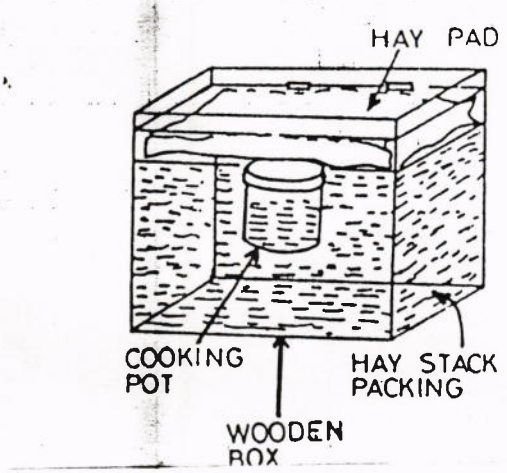


Fig. 1

2. Bardoli model box type solar cooker (Patel, 1992)

This was developed by Agricultural Tool Research Centre, Swaraj Ashram, Bardoli. This is a box type solar cooker kept on a stand for effective operation. It is like any other box type cooker, a rectangular box type unit with a double wall. The inner absorbing area is trapezoidal in section. The top consists of two transparent glass panels placed a few millimeters apart. The absorption area is painted black. Also the outside of the vessels are blackened for good absorption. In this cooker there is no need for tracking as the cooker is placed a little above the ground on a stand. The maximum temperature attained in the cooking space is 150°C. The cost of the unit is Rs. 2000 approximately. Like in all box type solar cookers while opening the glass paneled lid, the face and body are to be protected from the escaping steam and care has to be taken to protect hands with a thick cloth gloves while removing hot utensils from inside the cooker.

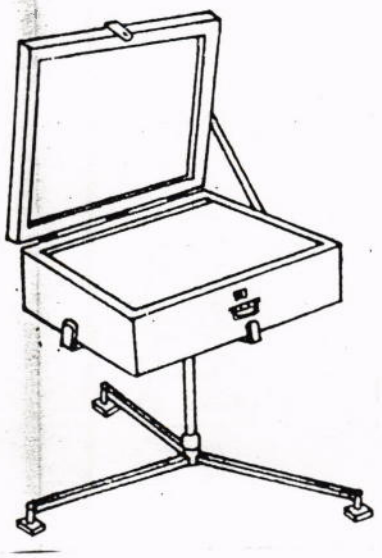


Fig. 2

3. Paper concentrator- The "Open Type" Cookers (Goetz, 1997)

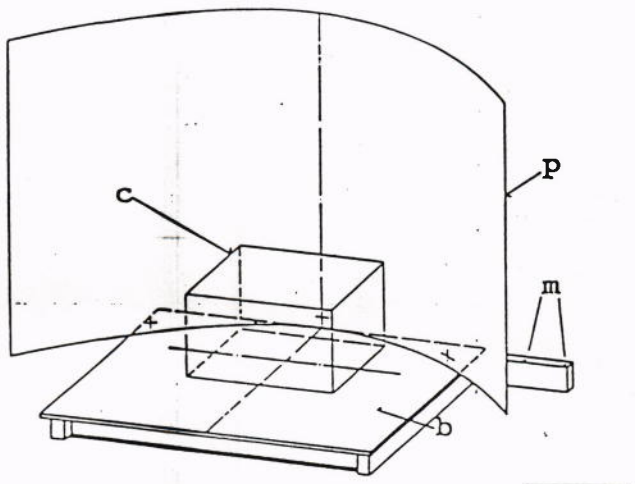


Fig.3

p: parabolic bent metal sheet with reflector foil

b: bottom with heat isolation and reflector foil

c: covering cap of glass (for covering the pot and its glass cover)

m: shadow marks for alignment of the solar cooker to the sun

A so formed reflector is more effective, enables a simple design and the negative effect of deviations from the exact alignment to the sun is minimised. However, a high energy concentration hit on and near the focus point. Such cookers cannot be used for baking because of burning of the surface of the burning good. All kind of cooking with water should be possible.

4. Model "INTI 3 IN 1" (Carpio, 1997)

The model INTI 3 IN 1 consists of a cooker with the characteristics of the three known systems box/ oven/ concentrator and parabolic. Its shape is a reflective parabola well closed in which the focal point is practically located at the bottom of the reflective surface where a dull black metallic flat tray creates a space or chamber underneath that reheats tray. The described shape allows the cooking pot to rest on the tray and the top will be closed with a double glass forming a box that is completed with a rectangular insulated base. The highest point of the parabola is located outside the glass and constitutes the reflector that accumulates solar rays to the interior through the window. This reflection that is part of the parabola is cut at the level of the glass surface to separate it from the walls of the box to allow the movement that will facilitate adjustment to the position with respect to the sun. For the orientation of the cooker small wheels can be added in the base of the box.

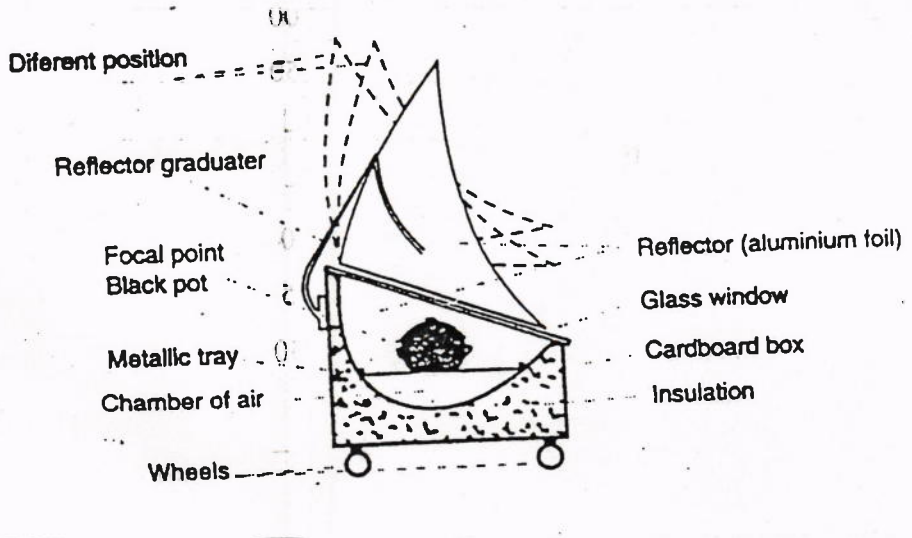


Fig.4

5. Parabolic solar steam cooker (Perumal and Jayaprakash, 1997)

A stainless steel cylinder of height 17.5cm and diameter 15.2cm is taken as cooking vessel. 25 holes of 1mm diameter are made at the bottom of the vessel. A stainless steel cover arrangement is embraced at the bottom of the cooking vessel in order to allow the steam to pass through the holes. An ½ inch steel pipe of length 3 cm is embraced at the center of the bottom cover. A G1 pipe of length 14cm and width 1.3cm is welded at the other end of the steel pipe. The other end of the G1 pipe is connected to the absorber tube. The entire set up is covered with glass wool to avoid thermal losses. The top portion of the stainless steel vessel is closed with stainless steel lid using rubber gasket. The temperature inside the cooking vessel is recorded continuously.

6. Cylindrical parabolic concentrator(Perumal and Jayaprakash, 1997)

Cylindrical parabolic concentrator of length 200cm, width of 100cm, curvature length 120cm, with focal length 25cm is mounted on a iron stand with 11° tilt focus south. The copper tubular absorber of length 200cm of diameter 1.2cm is fixed along the focal line of the concentrator. Manual tracking is done for every 10 minutes.

Heat is transferred from the solar collector through steam to cooker. The various temperatures are measured using sensitive thermometers. The insulation is also recorded. A constant pressure head arrangement is used for uniform flow of water through the absorber tube.

7. Box type solar cooker with storage (Sawhney, 1997)

This is a box type solar cooker for one vessel having PCM (Phase Change Material) to store the solar energy. The cooker consists of an aluminium absorbing tray with dimensions of .28m x .28m at the bottom, .40 x .40m at the top for the double glass lid and the vertical depth of the tray is .08m. The thickness of the aluminium sheet was .006m. In the center of the absorbing plate a cylindrical container of .165m in diameter and .02m in depth has been welded. The cooking pot is to be kept tightly in it. This container will provide a better heat transfer from the absorbing plate and PCM. More over aluminium tins were also provided at the inner side of the tray and cylindrical container. The outer tray of size .40 x .40 x .108 m is also made from the same aluminium sheet. The distance between the two trays was kept .025 m in the bottom side.

C. Prospects and Constraints in Solar Cookers

Solar cooker is a viable and promising technology for cooking food which is likely to help in meeting future domestic needs. It is a new kind of cooking device and does not require any conventional fuel for operation as it works with solar energy free gift of nature (Gambhir and Good, 1988 and Deshpande, 1994).

The advantages of using solar cooker over the conventional cooking as pointed out by Sharma,(1992) and Parikh and Parikh, (1996)

- No fuel maintenance or recurring cost
- No attention needed for cooking, no charing, no over flowing
- Simple to use
- No pollution of utensil, house or atmosphere
- Long durability and
- Nutritive delicious food with natural taste

Subramaniam (1983) and Devadas (1997) points out that solar cooker is a

- Novel way of cooking
- Pollution free cooking
- It can be conveniently used for cooking for a minimum of 200 days in a year in a country like India.
- Economy

Studies conducted by Rajagopal and Lakshmi Prabha (1993) add few more encouraging dimensions to the adoption of solar cooking like

- Easy to operate and maintain
- Helps to substitute LPG and fire wood during summer
- Frees homemaker from tension and
- Promotes health

Nandwani (1994) points out that solar cooker is a device which gives no smoke and keeps the environment clean. It carries the distinction of safety, simplicity, economy and preserving the environment. Moreover, the

solar cooker preserves the nutritive value of food as cooking is done on low temperature. Hence it is entirely a new kind of cooking device (Rai,1996).

Recent studies both at the national and international level have stated that solar cookers are the best alternative especially in developing countries like India. This would not only help in the deforestation problem but also provide protection for the ecology and environment (Metcalf, 1994).

Constraints in using Solar Cookers

Though India is a pioneer in the development of solar cookers, the device is still at its preliminary stage. Inspite of various efforts made, the widespread of solar cookers have not become possible due to various limitations including the impossibility of using solar cooker during the period lacking sufficient substitute for cooking.

According to Eleaner (1992) the constraints in using solar cookers are

1. Some food materials like chappathies and dosais require the manipulation during the cooking time. Hence they cannot be prepared with solar cooker.

2. Some food materials require high temperatures for baking. Hence they cannot be prepared with solar cooker since we are not able to reach such higher temperatures.

3. Foods cannot be cooked during the cloudy days and night time.

4. We have to cook depending on the sunshine.
5. Cooking with solar cooker takes comparatively longer time.
6. Not dependable on all days.
7. Adjustment of the reflector towards the sun is a strain on sunny days.

According to Devadas (1997)

- Solar cooker is costly. There is possibility of breakage of reflecting mirrors and the glass cover
- It is not possible to test the completion of cooking process off and on as the opening of the box releases the stored heat resulting in extension of cooking time.

Parikh and Parikh (1996) state that the solar cooker has the following limitations namely

1. One has to cook during the hours of the sun
2. One has to preplan the menu
3. One cannot cook on very cloudy days or during night
4. Unable to judge solar intensity
5. The sun rays must fall on the cooker throughout the cooking period. Shadow on the cooker hinders cooking
6. Large quantity of food cannot be cooked

Sharma (1994) rightly points out that unless the cookers are available in several sizes and price ranges are lighter and sturdier, they are unlikely to be seen under the sun where they belong.

D. Agencies Promoting Solar Cookers

Ministry of Non-conventional Energy Sources (MNES)

The Ministry of Non-conventional Energy Sources formed in 1992 is to promote renewable energy technologies and create an environment conducive for their commercialisation through innovative policy initiatives and strategies. The range of its activities covers renewable energy resource assessment, research and development, demonstration, extension, production in the areas of biogas, improved chulah, biomass, solar, wind energy and small hydro power. The sustained efforts of the ministry have resulted in the creation of widespread awareness among policy makers, administrators developmental agencies and the public about the benefits of increased use of renewable energy systems and devices.

The programmes of the ministry are implemented mainly through the State Energy Development Agencies and the State Electricity Boards. The Indian Renewable Energy Development Agency (IREDA) functions as the financing arm of the ministry (Bhatt and Reddy, 1982).

Tamil Nadu Energy Development Agency (TEDA), Chennai, Government of Tamil Nadu

The Tamil Nadu Energy Development Agency (TEDA) has been functioning in Tamil Nadu since 1st February 1985. This agency is a Government of Tamil Nadu undertaking, registered under the Tamil Nadu

Societies Registration Act, 1975 and is under the administrative control of Electronics, Science and Technology department of Government of Tamil Nadu.

The main objectives of TEDA are

- To promote the use of New and Renewable Sources of Energy (NRSE)
- To promote energy conservation activities
- To encourage research and development on renewable sources of energy.

With the guidance and financial support of Ministry of Non-conventional Energy Sources (MNES) and the Government of Tamil Nadu, TEDA has taken up statewide programmes relating to demonstration and extension of various NRSE systems.

Solar Cooker International (SCI) USA

Solar Cookers International, formed in 1987, is governed by a volunteer board of directors.

Solar Cooker International

- Promotes the spread of solar cooking and helps people and environments clean worldwide
- Provides worldwide information exchange
- Helps other organisations to adopt solar cooking to diverse needs
- Develops educational materials and training programmes.

Commission for Additional Sources of Energy (CASE)

Commission for Additional Sources of Energy had set up by the government of India with the following objectives

- To formulate and implement policies and programmes for development of renewable sources of energy
- To coordinate and intensify research and development activities in renewable sources of energy
- To plan, initiate, financially support, monitor and undertake integrated national research and development programmes in the areas of solar energy systems (CASE, 1982).

CASE has also entrusted the work of manufacturing and marketing of cookers to various state governments. In Maharashtra, the Maharashtra Small Scale Industries Development Corporation (MSSIDC) has taken up this responsibility (Sharma, 1983).

Indian Renewable Energy Development Agency (IREDA)

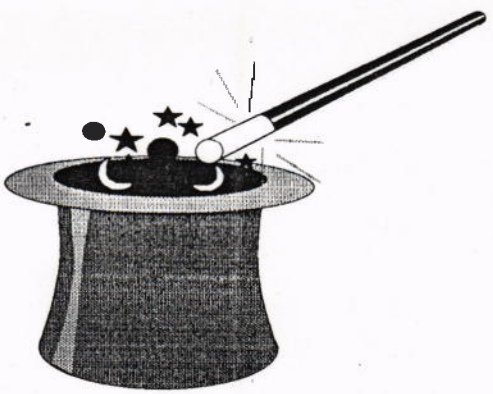
The main objective of IREDA is to act as a catalyst agent for accelerating commercialisation of new and renewable sources of energy. IREDA has been assigned the main task of administering a revolving fund to promote, develop and finance. The resource base of IREDA mainly consists of equits support from Government of India, grants from foreign and international organisations, borrowings and internal accruals.

E. Studies Conducted in Solar Cookers

1. Muthu and Raman (1992) studied the various models of solar cookers such as Murugu model, Universal and CAT model. Among the three Murugu model ranked the first. A solar cooker with less dimensions was fabricated and compared with Murugu model. The cost of the newly designed cooker was Rs. 300, weight was brought down from 12.5Kg to 6.8 Kg. The time taken was almost the same compared to Murugu model.

2. Jeyagowri and Varghese (1995) fabricated a new model "Aadavan" cooker based on Murugu model, which is adequate to cook a meal for a family consisting of 4 to 5 members. All the respondents cooked rice, dhal, potato, beans, carrot, egg, uppuma in the solar cooker. They were highly satisfied with the taste and texture of the foods cooked.

3. Jeyagowri and Devi (1998) conducted a study on four models of cookers such as Tulsi Gold, FRP point, Surya jyothi and Suncook solar cookers. Tulsi Gold found to be an efficient cooker in terms of time taken and palatability of the foods cooked in it.



METHODOLOGY

III METHODOLOGY

The methods and materials pertaining to the research on "Performance Study of 'Avinash' Model Solar Box Cooker" comprised of the following phases:

A. Selection of Solar Box Cookers
B. Selection of Area
C. Performance Study of Selected Solar Box Cookers
D. Evaluation of Solar Box Cookers

A. Selection of Solar Box Cookers

A study conducted by JeyaGowri and Devi (1998) on performance study of various models of solar box cookers namely TulsiGold, (Rohtas Electronics. Kanpur). FRP point (Lucknow), Surya Jyothi (New Delhi), and suncook (Norway) proved that Tulsi Gold and FRP point were equally good with regard to design, less time required for cooking and ease of maintenance. Since solar box cookers were not available in the local markets of Coimbatore it was difficult for the homemakers in this region to procure and use solar cooker. Therefore the Department of Family Resource Management of Avinashilingam Deemed University designed and developed a solar box cooker with the help of a local manufacturers of Filaments and Windings Private Ltd., 63, SIDCO Industrial Estate, Coimbatore- 21 in order to promote the use of solar box cookers in the Indian households. The main aim of

fabricating Avinash model solar cooker was to make the cooker available in the local markets of Coimbatore. The newly designed Avinash model solar cooker was compared with the best and efficient model Tulsi Gold cooker for its efficiency. Table I presents the details of Avinash and Tulsi Gold solar box cookers.

TABLE I

DETAILS OF AVINASH AND TULSI GOLD MODEL SOLAR COOKERS

S.No	Name of the Cookers	Promoting Organisations	Reasons for selection.
1.	Avinash	Department of Family Resource Management in Avinashiligam Deemed University with the help of Filaments and Windings Private Ltd. 63,SIDCO Industrial Estate. Coimbatore – 21.	Easy to carry like a suitcase, novel, design attractive,more cooking capacity availability of electrical backup convenient size and shape.
2.	Tulsi Gold	Rohtas Electronics, Kanpur.	Easy mobility, attractive novel design, more cooking capacity, availability of electrical back up, convenient size.

Plate I illustrates the solar cookers selected for the study. Table II gives the features of Avinash and Tulsi Gold model solar cookers.

TABLE II

FEATURES OF AVINASH AND TULSI GOLD MODEL SOLAR COOKERS

S.No	Components	Materials Used		Dimensions in cms	
		Avinash	Tulsi Gold	Avinash	Tulsi Gold
1.	Outer box	Fibre reinforced plastic	Fibre reinforced plastic	55 x 54	54 x 54
2.	Inner box	Aluminium	Aluminium	46 x 46	48 x 48
3.	Double glass lid	Glass	Glass	48 x 48	50.5 x 50.5
4.	Reflector	Mirror	Mirror	53 x 54.5	47 x 47
5.	Insulating material	Glass wool	Glass wool	---	---

AVINASH

TULSI GOLD

PLATE I SOLAR COOKERS SELECTED FOR THE STUDY

Avinash model solar cooker

Avinash model solar cooker was designed and developed by the Department of the Family Resource Management of Avinashilingam Deemed University with the help of Filaments and Windings Private Ltd., at Coimbatore. Avinash model solar cooker is a hybrid cooker with electrical back up. It is simple, strong and easy to handle. The salient features of this cooker is that the outer body is made up of Fibre reinforced plastic which is very strong providing the needed durability to the cooker. In this cooker four cooking containers could be used for cooking. Two of them are of 18 cms diameter and the others of 15 cms diameter.

Tulsi Gold solar cooker

Tulsi Gold solar cooker is manufactured by Rohtas Electronics at Kanpur. Tulsi Gold solar cooker is a hybrid solar cooker with electrical back up. In this solar cooker four cooking containers could be used for cooking . Two of them were of 18cms diameter and the others were of 15cms diameter. It is designed to meet the cooking needs of women all over the world. It is built to tackle the toughest cooking task, easy to use and economical. It cooks most healthy, flavoured and nutritious food to build up body, mind and soul and a strong immune system. The electrical back up provided in this cooker is an added advantage. As it was stated earlier a study proved that FRP point and Tulsi Gold solar cookers were equally good in efficiency. Thus one of these

cookers Tulsi Gold was selected as a model for comparing and testing the efficiency of Avinash model solar cooker.

B. Selection of Area

The place selected to conduct experiments with Avinash model and Tulsi Gold solar cookers was the open terrace of Annai Arul building of the Avinashilingam Deemed University campus. It was chosen by the investigator based on the following criteria such as

- Stillness of air
- Availability of sunlight
- Free from shadow and interruptions
- Convenience

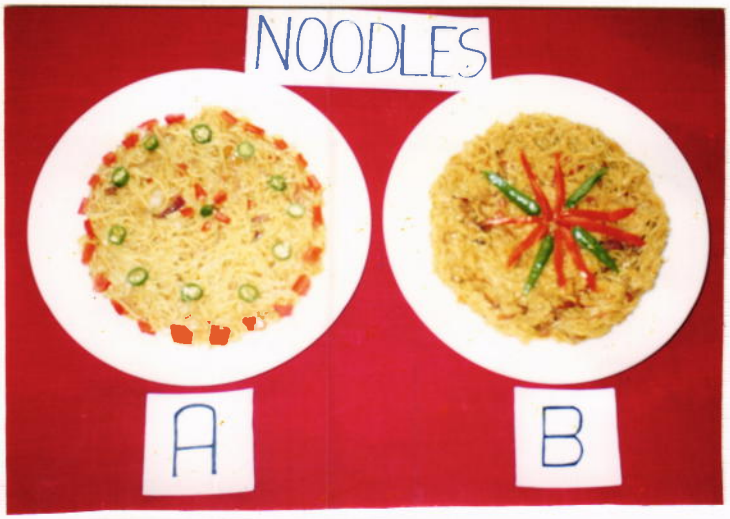
C. Performance Study of Selected Solar Box Cookers

The performance study of selected solar box cookers involved

1. Selection of food items and
2. Conducting cooking experiments.

1. Selection of food items

Twenty five common South Indian dishes were selected for the cooking experiment representing the major food groups namely cereals, pulses, vegetables, milk and milk products, fleshy foods. The selected food items are given in the Table III.



A- AVINASH **B-TULSI GOLD**

PLATE –II FOOD ITEMS PREPARED IN THE SELECTED SOLAR BOX COOKERS

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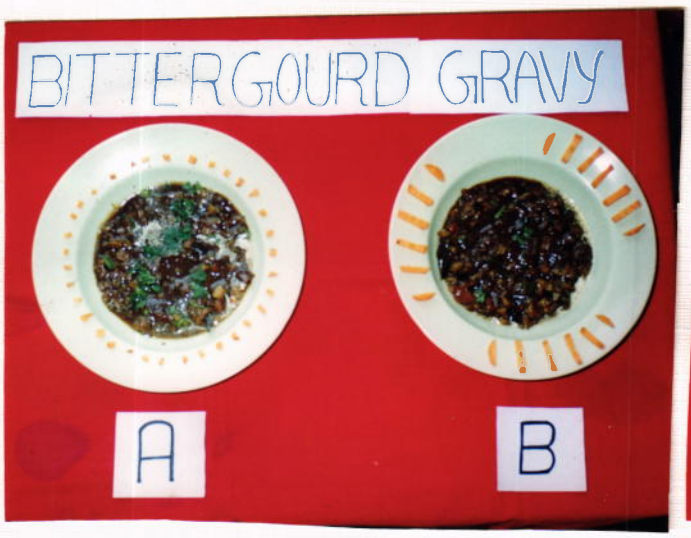
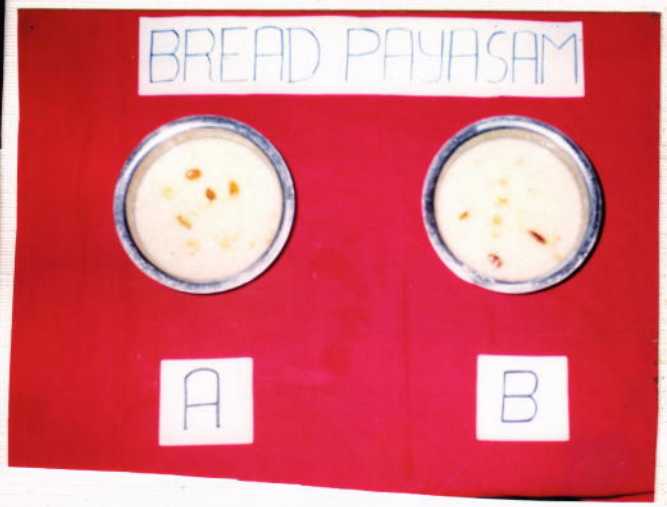
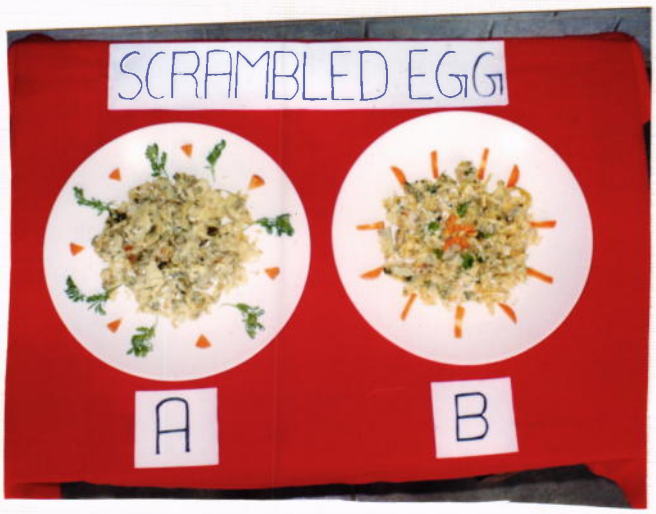






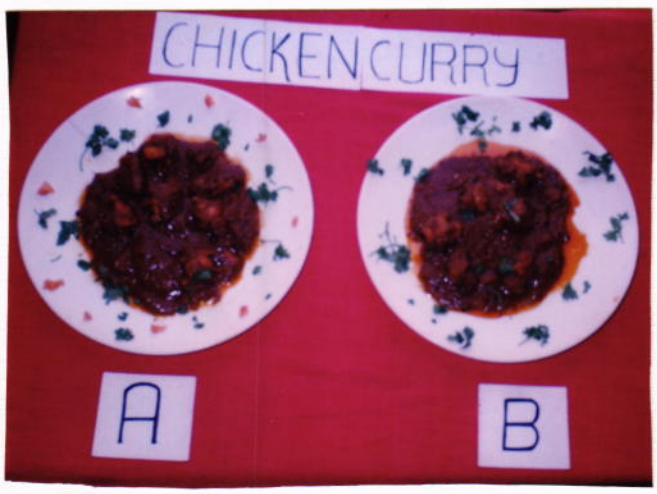


PLATE –II FOOD ITEMS PREPARED IN THE SELECTED SOLAR BOX COOKERS

2. Conducting cooking experiments

The cooking experiments were conducted in Avinash model and Tulsi Gold cookers simultaneously in order to find out their efficiency. Equal amount of selected food items were cooked in both the models of solar cookers. The recipes used for preparation of food items are given in Appendix (I). Seasoning was done before or after cooking depending upon the type of food items prepared, since it can be done only in conventional fuel. Plate (III) visualises the cooking experiments being done in selected solar box cookers.

Time taken to cook and palatability of the foods cooked in the solar cookers were observed. The time taken and fuel consumption to cook all the selected items in LPG were also noted. Thus one will know how much fuel (LPG) could be conserved if we use the solar cooker to cook the daily menu. The different types of vessels such as aluminium and stainless steel were compared to find out the time and temperature difference between them. Apart from these solar intensity obtained for the days of experiments was also recorded. The period selected to conduct the study were the months of summer (January, February and March) because the solar intensity and sunshine hours are comparatively high. In these months the experiment was conducted to evaluate the performance of Avinash model cooker in terms of time taken to cook the various food items and palatability of the foods cooked in solar cooker was compared with Tulsi Gold.

AVINASH

TULSI GOLD

PLATE –III CONDUCT OF COOKING EXPERIMENTS IN SELECTED SOLAR BOX COOKERS

D. Evaluation of Solar Box Cookers

According to Bharathi and Jacintha (1995) evaluation is used to assess what has been done and how effective the process in relation to the achieved goals. The efficiency of these cookers were evaluated by selecting a panel of judges.

1. Selection of judges

Twenty five under graduate students majoring in Interior Design from the Department of Family Resource management from Avinashilingam Deemed University were chosen as judges to evaluate the palatability of food items cooked in the solar cookers and also to evaluate the physical features of the cookers. The reasons for selecting these students were that they were familiar with solar cooker since they belong to Family Resource management department, willing to evaluate the food items and co-operation extended by them. Moreover the students have undergone a residence stay practicals for a period of one month. During that time the cookers facilitated them to simplify their cooking for dinner. They kept dhals, potatoes and channa, in the morning and they could use these items for evening tiffin and dinner. The judges evaluated the cookers by testing the palatability of the foods cooked in the cooker and check the physical features of the cookers.

a. Palatability of the foods cooked in the solar cookers

Sensory evaluation tests are used in situations in which there are two types of stimuli say A and B and the investigator wants to know whether these stimuli are sensorily discriminable with respect to a particular sensory effect of class of sensory effects that is a particular taste, odour, flavour or any other type of sensory experience .

Score card was administered to the selected panel of judges to evaluate the palatability of the foods cooked in selected solar box cookers. (Appendix II and plate IV) water was given to the judges after tasting the prepared food items from each cooker to make the evaluation perfect.

b. Physical features of cookers.

The same set of judges were given ample time to examine the physical features of cookers using check list (Appendix III). Check list is a type of questionnaire in the form of a set of items which the respondent is asked to check (Kothari, 1993).Plate (V) shows the evaluation of the physical features of Solar cookers by selected judges.

As per the suggestion given by Dr.S.K.Philip consultant in solar cookers Renewable Energy Instiute Vallab Vidhya Nagar, Gujarat, India. The following tests were carried out by the investigator.

PLATE IV PALATABILITY OF THE FOODS COOKED IN SELECTED SOLAR BOX COOKERS

PLATE –V PHYSICAL FEATURES OF THE SELECTED SOLAR BOX COOKERS

(i) Paper test

Paper test is the test used to find out the air tightness of the cooker. The paper was kept in between the double glass lid and the inner cooking box and the glass lid was closed and the investigator tried to take the paper out. If the paper doesn't come out easily then it will be considered that the cooker is fabricated well. Plate (VI) shows the conduct of paper test in the selected cookers.

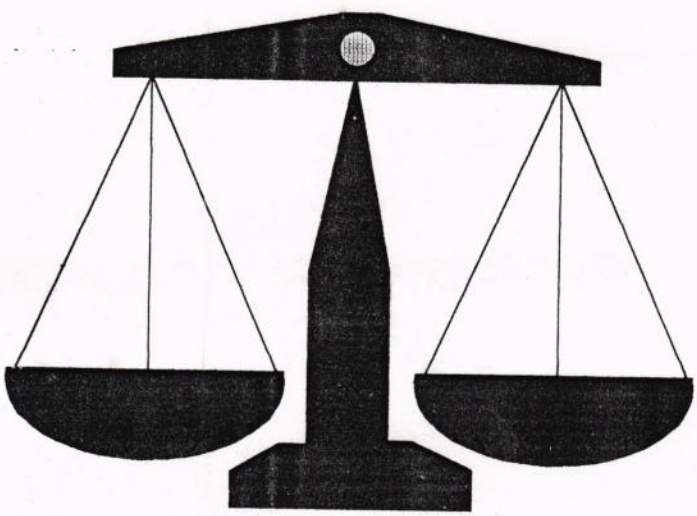
(ii) Weight

The weight of the solar cooker was found out by using weighing balance. The water was poured in the inner box and it was allowed to retain in the cooker for ten minutes. Then the water was poured outside and dried thoroughly. Again the weight was noted to find out whether there is any leakage in the cooker. If there is any leakage in the cooker the weight of the cooker will be more after pouring water from the cooker.

AVINASH

TULSI GOLD

PLATE-VI CONDUCT OF PAPER TEST IN SELECTED SOLAR BOX COOKERS



RESULTS & DISCUSSION

IV RESULTS AND DISCUSSION

Results and discussion pertaining to the research on "Performance Study of "Avinash" Model Solar Box Cooker" are dealt under the following headings

A. Performance of Avinash Model Cooker Compared with Tulsi Gold Solar Cooker.

B. Palatability of the Foods Cooked in Avinash Model and Tulsi Gold Solar Cookers.

C. Evaluating the Physical Features of Avinash Model and Tulsi Gold Solar Cookers.

A. Performance of Avinash Model Cooker Compared with Tulsi Gold Solar Cooker

Performance of Avinash model compared with Tulsi Gold cooker included aspects such as temperature recorded, time taken to cook selected food items in both the cookers and fuel spent and cost incurred on cooking selected food items using LPG .

1. Temperature recorded in Avinash model and Tulsi Gold solar cookers.

Table IV gives the temperature recorded in Avinash model and Tulsi Gold solar cookers.

TABLE IV

TEMPERATURE RECORDED IN AVINASH MODEL AND TULSI GOLD SOLAR COOKERS

Days	Time	Temperature in °C	
		Avinash	Tulsi Gold
Day I	9.30 am	66.0	64.0
	11.30 am	98.0	96.0
	2.30 pm	95.2	93.0
Day II	9.30 am	68.1	66.0
	11.30 am	98.0	96.0
	2.30 pm	92.0	90.0
Day III	9.30 am	72.0	69.0
	11.30 am	92.0	89.0
	2.30 pm	88.5	85.0
Day IV	9.30 am	64.0	62.0
	11.30 am	98.0	96.0
	2.30 pm	90.0	87.0
Day V	9.30 am	72.5	70.0
	11.30 am	98.0	95.0
	2.30 pm	94.1	91.0

The temperature was recorded in both the cookers at two to three hours interval from 9.30 am to 2.30 pm for five days. The temperature observed was high in Avinash model cooker when compared to Tulsi Gold on all five days at all times with 2-3°C temperature difference. The temperature recorded was high at 11.30 am on all the days in Avinash (98°C) and Tulsi Gold cooker (96°C). The temperature obtained in the cookers indicate that foods can be easily cooked in both the cookers.

2. Temperature recorded in Avinash model and Tulsi Gold cookers during cooking.

Table V shows the temperature recorded in Avinash model and Tulsi Gold solar cookers during cooking.

TABLE V

TEMPERATURE RECORDED IN AVINASH MODEL AND TULSI GOLD SOLAR COOKERS DURING COOKING

S. No.	Food items	Amount in gms	Intensity Solar radiation cal/cm^2/day	Cooking temperature (°C)	
				Avinash	Tulsi Gold
1.	Sweet pongal	150	460.2	88.0	84.0
2.	Ven pongal	150	495.6	86.0	83.5
3.	Noodles	100	407.1	96.5	94.5
4.	Tomato rice	150	504.5	98.0	94.0
5.	Dhal rice	150	540.0	98.0	96.0
6.	Peas poriyal	100	442.8	95.0	92.0
7.	Boiled green gram	100	475.6	90.0	88.0
8.	Bengal gram sambar	100	442.8	92.0	90.0
9.	Horse gram chutney	100	459.2	92.0	88.0
10.	Boiled channa	100	426.4	98.0	96.0
11.	Beans poriyal	150	477.9	95.0	93.5
12.	Cauliflower poriyal	150	460.2	88.0	86.0
13.	Potato masal	100	442.5	98.0	96.0
14.	Bitter gourd gravy	100	380.6	88.0	88.0
15.	Brinjal gravy	100	497.9	98.0	94.0
16.	Carrot poriyal	150	389.4	94.0	92.5
17.	Coffee	200	410.0	97.5	93.5
18.	Tea	200	410.0	96.5	95.0
19.	Bread payasam	150	459.2	98.0	94.0
20.	Vermicelli payasam	150	442.8	98.0	94.0
21.	Chicken kurma	100	412.6	97.0	95.0
22.	Mutton curry	100	412.6	97.0	95.0
23.	Boiled egg	120	431.2	97.0	93.0
24.	Scrambled egg	120	454.3	86.0	82.0
25.	Egg omelet	120	469.7	88.0	84.0

It is clear from the Table V that the maximum temperature was recorded in Avinash model solar cooker when compared to Tulsi Gold cooker. While cooking various selected food items except bitter gourd gravy, when there was a maximum solar radiation of 540 cal/cm^2 the cooking temperature observed in Avinash cooker was 98°C whereas in Tulsi Gold 96°C for preparing dhal rice. The highest cooking temperature 98°C was obtained in Avinash model cooker for various preparations such as tomato rice, dhal rice, boiled channa, potato masal, brinjal gravy, bread payasam and vermicelli payasam, whereas Tulsi Gold cooker observed the maximum temperature of 96°C for dhal rice, potato masal and boiled channa irrespective of solar radiation. The difference in solar radiation and cooking temperature observed in the cookers may be due to the nature of food materials and the recipes used for preparation.

3. Temperature recorded while cooking in different vessels in Avinash model and Tulsi Gold solar cookers.

Table VI depicts the temperature recorded while cooking different vessels in both the cookers.

TABLE VI
TEMPERATURE RECORDED WHILE COOKING IN DIFFERENT VESSELS IN AVINASH MODEL AND TULSI GOLD SOLAR COOKERS

S. No.	Items cooked	Temperature (°C)			
		Avinash		Tulsi Gold	
		Aluminium	Stainless steel	Aluminium	Stainless steel
1.	Sweet pongal	88.0	84.0	84.0	80.0
2.	Ven pongal	86.0	83.0	83.5	80.5
3.	Noodles	96.5	92.5	94.5	90.5
4.	Tomato rice	98.0	94.0	94.0	90.0
5.	Dhal rice	98.0	95.0	96.0	92.5
6.	Peas sundal	95.0	92.5	92.0	90.0
7.	Boiled green gram	90.0	87.0	88.0	85.0
8.	Horse gram chutney	92.0	88.0	88.0	84.0
9.	Boiled channa	98.0	94.0	96.0	92.0
10.	Bengal gram sambar	92.0	89.5	90.0	87.5
11.	Beans poriyal	95.0	91.0	93.5	89.0
12.	Cauli flower poriyal	88.0	85.0	86.0	83.0
13.	Potato masal	98.0	94.0	96.0	92.0
14.	Bitter gourd gravy	88.0	84.0	88.0	84.0
15.	Brinjal gravy	98.0	95.5	94.0	91.5
16.	Carrot poriyal	94.0	91.0	92.5	89.5
17.	Coffee	97.5	93.5	93.5	88.5
18.	Tea	96.5	92.5	95.0	91.0
19.	Bread payasam	98.0	94.0	94.0	90.0
20.	Vermicelli Payasam	98.0	94.0	94.0	90.0
21.	Chicken kurma	97.0	95.0	95.5	92.0
22.	Mutton curry	97.0	95.0	95.5	92.0
23.	Boiled egg	97.0	94.0	93.0	90.0
24.	Scrambled Egg	86.0	83.0	82.0	79.0
25.	Egg omelet	88.0	84.0	84.0	80.0

Temperature was recorded while cooking foods in aluminium and stainless steel vessels in Avinash model and Tulsi Gold cookers. The maximum temperature was obtained in aluminium vessels compared to stainless steel for all the food preparations in both the cookers. There was a meagre difference of 2-4°C temperature was noted between aluminium and stainless steel vessels in both the cookers. The aluminium vessel recorded more temperature compared to stainless steel vessel. It is a known fact that aluminium is a good conductor of heat. So maximum temperature was obtained and the foods cooked in aluminium vessel was faster than stainless steel vessel. Comparing the foods cooked in aluminium and stainless steel vessels in both the cookers, Avinash model cooker recorded more temperature of 2-4°C than Tulsi Gold cooker.

4. Time taken to cook various food items in Avinash model and Tulsi Gold cookers.

This heading includes the time taken to cook cereals, pulses, vegetables, milk and milk products and fleshy foods.

a. Time taken to cook cereal preparations.

Table VII and Figure 5 depict the time taken to cook cereal preparations in both Avinash model and Tulsi Gold solar cookers.

TABLE VII

TIME TAKEN TO COOK CEREAL PREPARATIONS

Items cooked	Solar intensity cal/cm^2 /day	Sun shine hours	Amount in gms	Time taken in minutes	
				Avinash	Tulsi Gold
Sweet pongal	460.2	7.2	150	90	90
Ven pongal	495.6	9.7	150	85	95
Noodles	407.1	5.9	100	20	25
Tomato rice	504.5	10.5	150	100	100
Dhal rice	540.0	11.1	150	90	100

It is noted that Avinash cooker seems to be an efficient cooker than Tulsi Gold since it took equal or less time to cook various items. The time taken to cook sweet pongal (90 minutes), tomato rice (100 minutes) and dhal rice (90 minutes) in both the cookers whereas for ven pongal and noodles preparations a meagre difference of 0-5 minutes extra time was taken by Tulsi Gold cooker.

b.Time taken to cook pulse preparations

Table VIII and Figure 6 present the time taken to cook pulse preparations such as peas sundal, boiled green gram, bengal gram sambar, horse gram chutney and boiled channa.

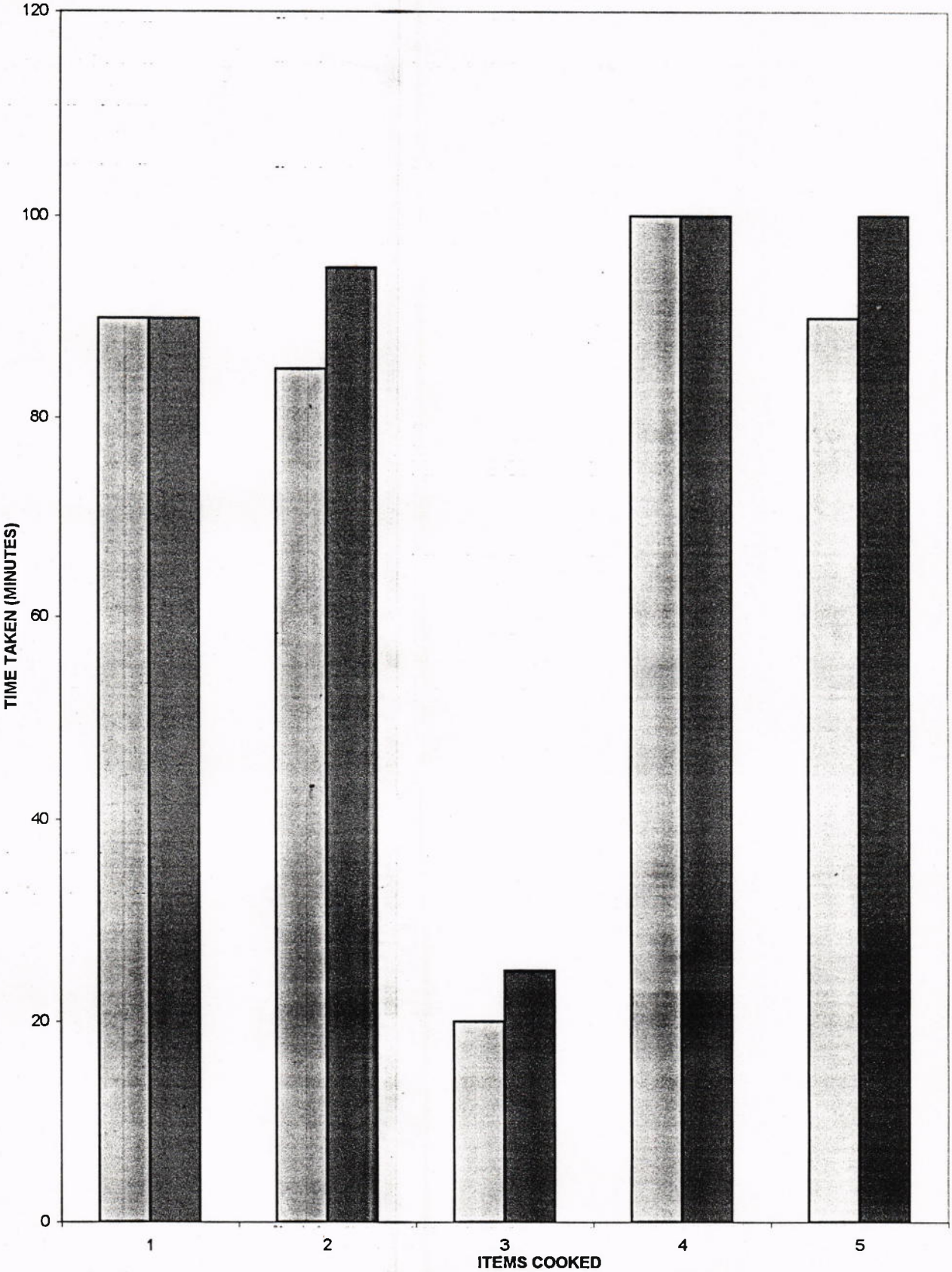


Fig. 5 TIME TAKEN TO COOK CEREAL PREPARATIONS

1. Sweet Pongal 2. Ven Pongal 3. Noodles 4. Tomato Rice 5. Dhal Rice

TABLE VIII

TIME TAKEN TO COOK PULSE PREPARATIONS

Items cooked	Solar intensity cal/cm^2 / day	Sun shine hours	Amount in gms	Time taken in minutes	
				Avinash	Tulsi Gold
Peas Sundal	442.8	9.1	100	90	95
Boiled green gram	475.6	10.7	100	80	85
Bengal gram Sambar	442.8	9.1	100	90	90
Horse gram chutney	459.2	9.4	100	90	100
Boiled channa	426.4	9.7	100	100	110

Avinash model cooker took less time to prepare peas sundal (90 minutes) boiled green gram (80 minutes) horse gram chutney (90 minutes) and boiled channa (100 minutes) when compared to Tulsi Gold cooker, which took extra 5-10 minutes to prepare all these items. Bengal gram sambar preparation consumed equal time in both the cookers (90 minutes)

c. Time taken to cook vegetable preparations.

Table IX and Figure 7 illustrate the time taken to cook vegetables in both the cookers

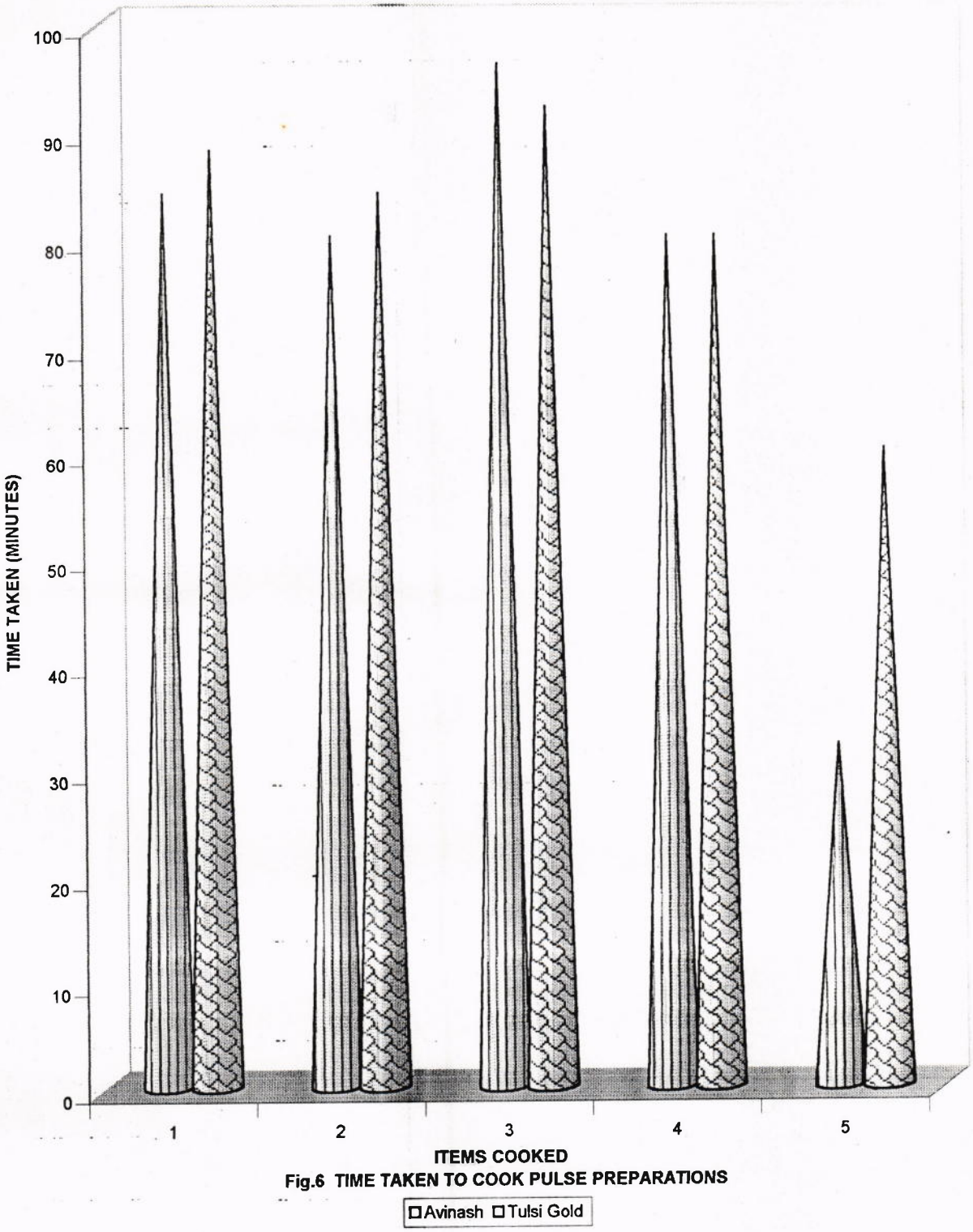


Fig.6 TIME TAKEN TO COOK PULSE PREPARATIONS

1. Peas Sundal 2. Boiled Green Gram 3. Bengal Gram Sambar 4. Horse Gram chutney 5. Boiled Channa

TABLE IX

TIME TAKEN TO COOK VEGETABLE PREPARATIONS

Items cooked	Solar intensity cal/cm^2/ day	Sun shine hours	Amou nt in gms	Time taken in minutes	
				Avinash	Tulsi Gold
Beans poriyal	477.9	9.0	150	95	105
Cauliflower poriyal	460.2	9.3	150	60	70
Potato masal	442.5	8.8	100	60	65
Bitter guard gravy	380.6	6.1	100	30	30
Brinjal gravy	477.9	9.4	100	90	100
Carrot poriyal	389.4	6.7	150	50	55

For all the vegetable preparations Avinash model cooker needed less time compared to Tulsi Gold cooker except bitter gourd gravy which took equal time in both the cookers. There was only 5-10 minutes extra time was required to cook various vegetable preparations in Tulsi Gold cooker.

d. Time taken to cook milk and milk products

The time taken to cook milk and milk products are presented in Table X and Figure 8.

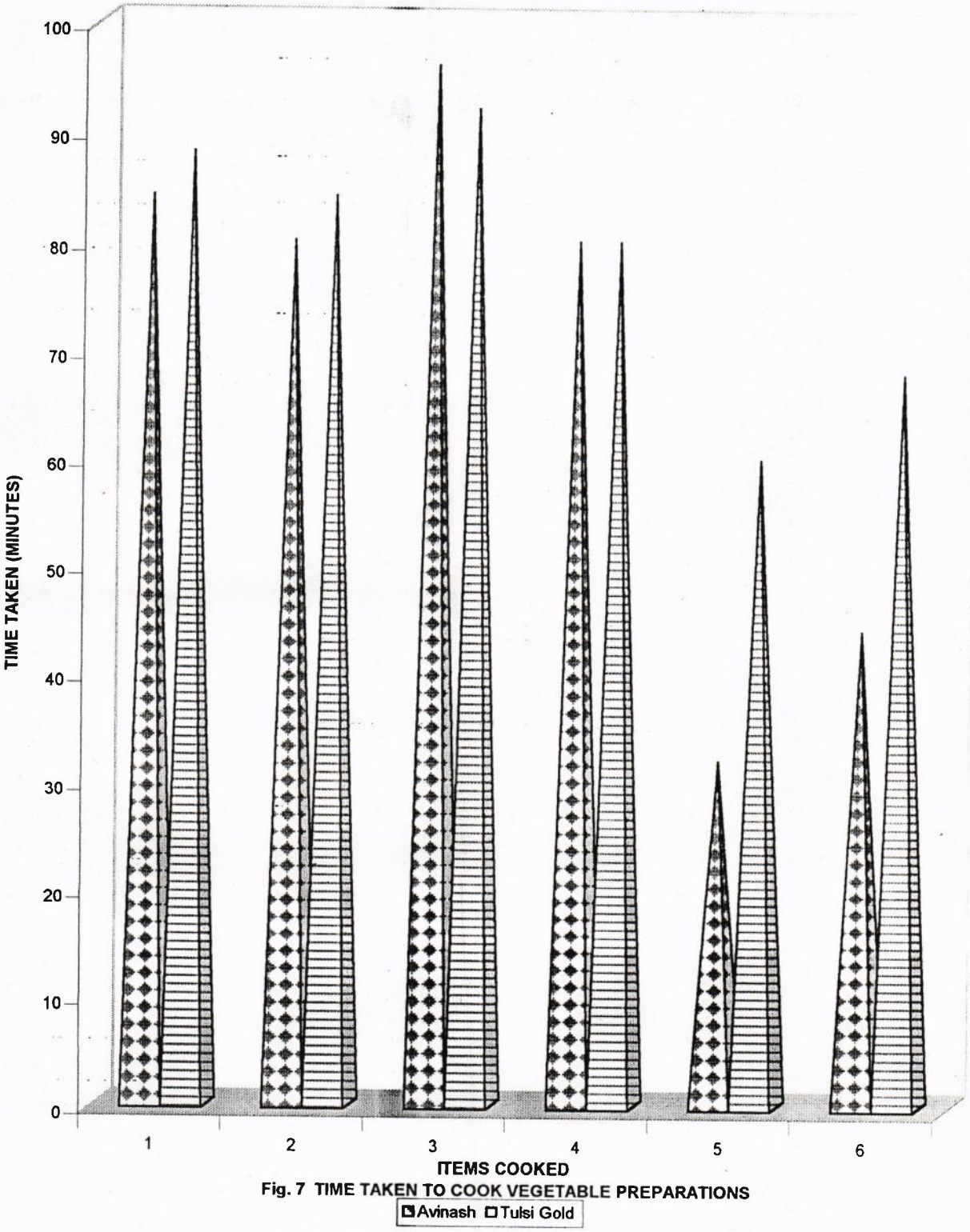


Fig. 7 TIME TAKEN TO COOK VEGETABLE PREPARATIONS

1. Beans Poriyal 2. Cauliflower poriyal 3. Potato Masal 4. Bitterguard gravy 5. Brinjal gravy 6. Carrot Poriyal

TABLE X

TIME TAKEN TO COOK MILK AND MILK PRODUCTS

Items cooked	Solar intensity cal/cm^2/ day	Sun shine hours	Amount in gms	Time taken in minutes	
				Avinash	Tulsi Gold
Coffee	410.0	7.9	200	30	35
Tea	410.0	7.9	200	30	35
Bread payasam	459.2	10.4	150	25	30
Vermicelli payasam	442.8	9.6	150	35	40

The time required for milk preparations in Avinash model cooker was less compared to Tulsi Gold cooker. For bread payasam preparation the time consumed by Avinash model cooker was 25 minutes and in Tulsi Gold cooker 30 minutes. The maximum time 35 minutes was required to prepare vermicelli payasam in Avinash cooker and 40 minutes was consumed by Tulsi Gold cooker. Coffee and Tea preparations needed 30 minutes in Avinash cooker and 35 minutes in Tulsi Gold cooker. The time difference between the preparations reveal that it may be due to the texture of the products and the method of recipes used for the preparations.

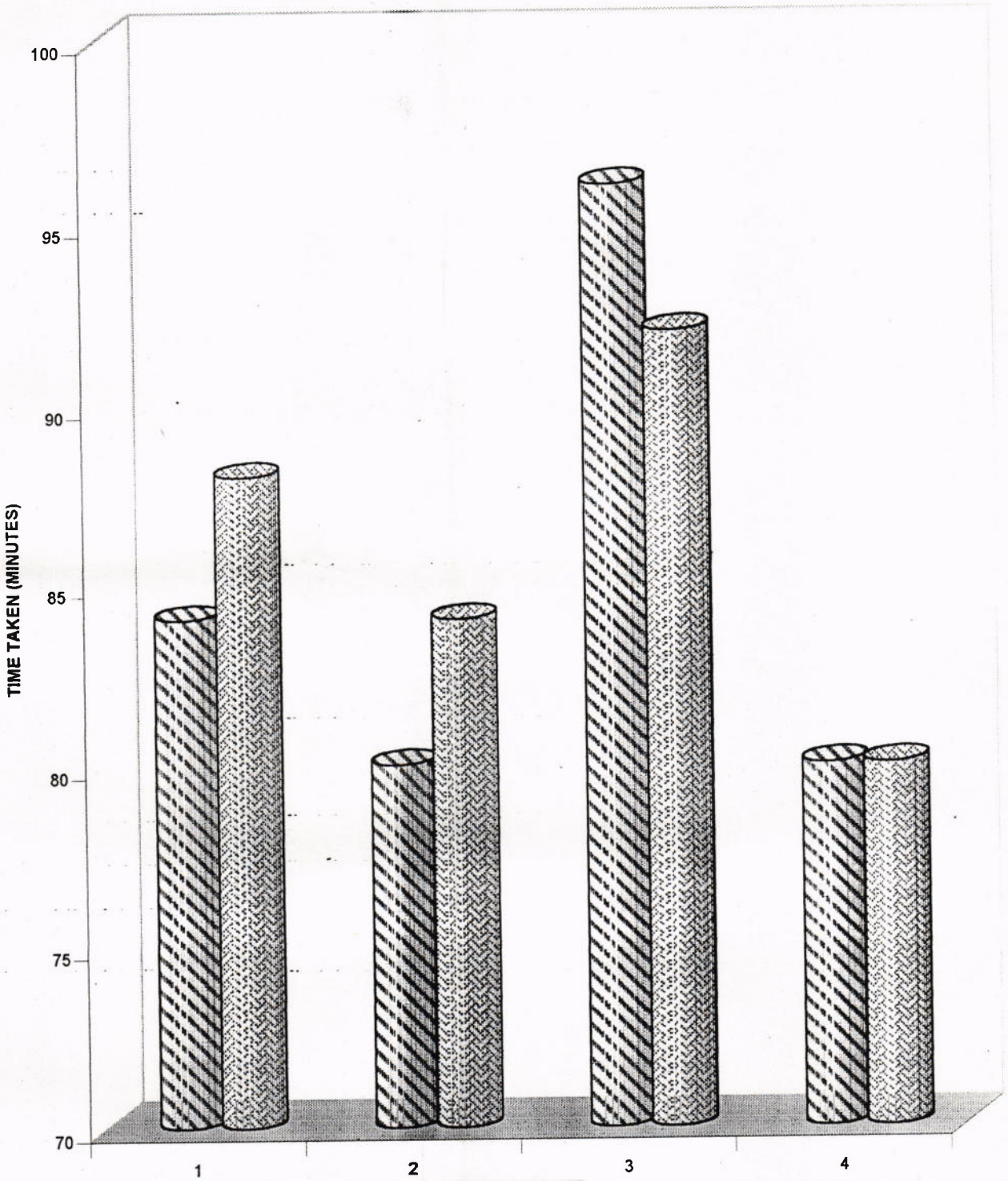


Fig.8 TIME TAKEN TO COOK MILK AND MILK PRODUCTS

1. Coffee 2. Tea 3. Bread Payasam 4. Vermicelli Payasam

e. Time taken to cook fleshy foods

The time taken to cook fleshy foods are visualised in Table XI and Figure 9.

TABLE XI

TIME TAKEN TO COOK FLESHY FOODS

Items cooked	Solar intensity cal/cm^2 /day	Sun shine hours	Amount in gms	Time taken in minutes	
				Avinash	Tulsi Gold
Chicken kurma	412.6	8.2	120	120	130
Mutton curry	412.6	8.2	120	125	135
Boiled egg	431.2	9.5	120	20	23
Scrambled egg	454.3	10.7	120	20	25
Egg omelet	469.7	10.4	120	23	23

Usually fleshy foods consume more time for cooking in conventional method. Avinash model took less time compared to Tulsi Gold cooker to prepare all the fleshy food items. For preparing chicken kurma and mutton currry Avinash model required 120 minutes and 125 minutes respectively whereas Tulsi Gold needed extra 10 minutes for both the preparations. Boiled egg and scrambled egg took 20 minutes and egg omelet preparation needed 23 minutes in Avinash cooker. Tulsi Gold Cooker required extra 2-5 minutes for all the egg preparations. Correlation between the time taken to cook all the food items and the solar radiation was statistically analysed. The correlation values for Avinash - .2834 and Tulsi Gold - .1403. Thus it was prooved that when the solar radiation was more the time taken to cook the food items was less.

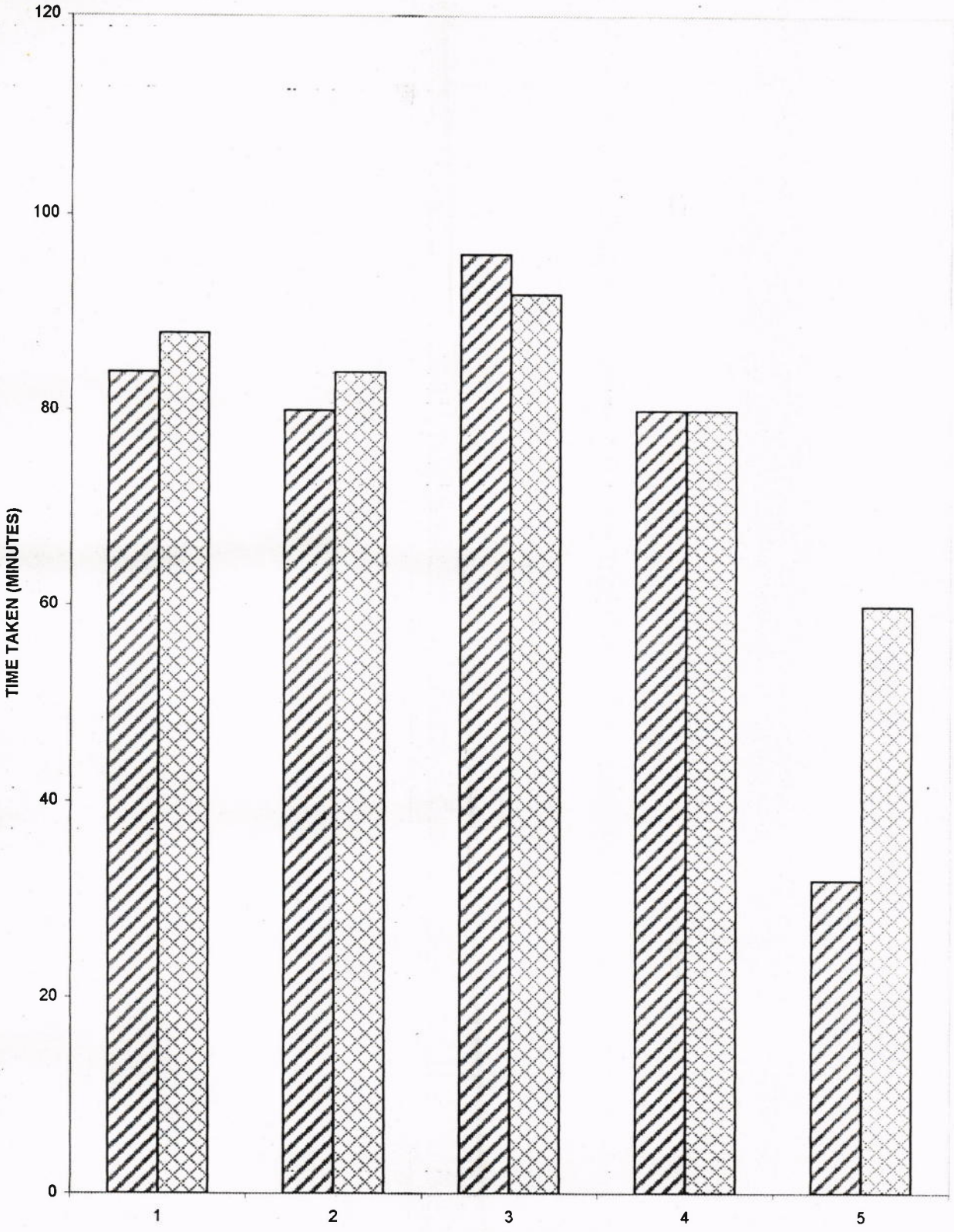


Fig.9 TIME TAKEN TO COOK FLESHY FOODS

1. Chicken Kurma 2. Mutton Curry 3. Boiled Egg 4. Scrambled Egg 5. Egg Omelet

5.Time taken, fuel spent and cost incurred on cooking food items using LPG.

Table XII visualises the time taken, fuel spent and cost incurred on cooking selected food items using LPG.

TABLE XII

TIME TAKEN, FUEL SPENT AND COST INCURRED ON COOKING FOOD ITEMS USING LPG

Items cooked	Quantity in gms	Total time taken in minutes	Amount of fuel spent in gms	Cost in Rs.
Sweet pongal	200	30	151	1.71
Ven pongal	200	30	151	1.71
Noodles	100	7	35	0.40
Tomato rice	150	30	151	1.71
Dhal rice	150	30	151	1.71
Peas Sundal	100	20	100	1.13
Boiled green gram	100	25	125	1.42
Horse gram chutney	100	20	100	1.13
Boiled channa	100	30	151	1.71
Bengal gram sambar	100	25	125	1.42
Beans poriyal	150	15	75	0.85
Cauliflower poriyal	150	20	100	1.13
Potato masal	100	20	100	1.13
Bitter gourd gravy	100	15	75	0.85
Brinjal gravy	150	20	100	1.13
Carrot poriyal	150	12	60	0.68
Coffee	200	5	25	0.28
Tea	200	5	25	0.28
Bread payasam	100	10	50	0.56
Vermicelli payasam	150	10	50	0.57
Chicken kurma	120	35	176	1.99
Mutton curry	120	45	226	2.56
Boiled egg	60	6	30	0.34
Scrambled egg	60	8	40	0.45
Egg omelet	120	4	20	0.22

It is a known fact that less time and minimum fuel is required to cook selected food items using LPG. It is found that the preparation of various types of selected 25 food items required 20-125 minutes in Avinash model cooker whereas Tulsi gold consumed 23-135 minutes for the same. But using LPG needed only 4-45 minutes for preparing the same selected items. The total cost incurred on preparing the selected food items is Rs. 30.36. The total amount of fuel spent for various food preparations is 2.392 kgms.

Even though the time taken to cook the foods in solar cooker was more compared to LPG we could conserve fuel cost using solar cooker which needs only initial investment. It can be used for life time without any further expenditure for food preparations using freely available solar energy.

B. Palatability of the Foods Cooked in Avinash Model and Tulsi Gold Solar Cookers.

This includes information on palatability of the foods cooked in Avinash model cooker compared to Tulsi Gold cooker.

1. Palatability of the foods cooked in Avinash model solar cooker.

The mean score awarded for the palatability of the foods cooked in Avinash model cooker are listed in Table XIII

TABLE XIII

MEAN SCORE AWARDED FOR THE PALATABILITY OF THE FOODS COOKED IN AVINASH MODEL COOKER

S. No	Items cooked	Criteria				Total (20)	Perce -ntage
		Colour (5)	Taste (5)	Texture (5)	Appea -rance		
1.	Sweet pongal	4.5	5	5	5	19.5	97.5
2.	Ven pongal	3	5	4	4	16	80
3.	Noodles	4.5	5	4	5	18.5	92.5
4.	Tomato rice	4.5	5	5	5	19.5	97.5
5.	Dhal rice	5	5	5	4	19	95
6.	Peas sundal	4	4	4	4	16	80
7.	Boiled green gram	4.5	5	5	5	19.5	97.5
8.	Horse gram chutney	5	5	4	4	18	90
9.	Boiled channa	5	4	4	4	17	85
10.	Bengal gram sambar	4.5	5	4.5	5	19	95
11.	Beans poriyal	4	5	4.5	4	17.5	87.5
12.	Cauliflower poriyal	4.5	5	5	5	19.5	97.5
13.	Potato masal	5	5	4.5	4.5	19	95
14.	Bittergourd gravy	4.5	5	4.5	5	19	95
15.	Brinjal gravy	5	5	4	4	18	90
16.	Carrot poriyal	4	5	4	5	18	90
17.	Coffee	4	4	5	4	17	85
18.	Tea	4	4	5	4	17	85
19.	Bread payasam	4.5	5	5	5	19.5	97.5
20.	Vermicelli payasam	5	5	4	4	18	90
21.	Chicken kurma	5	5	4.5	5	19.5	97.5
22.	Mutton curry	4.5	5	4.5	5	19	95
23.	Boiled egg	4	5	4	5	18	90
24.	Scrambled egg	4.5	5	5	5	19.5	97.5
25.	Egg omelet	4.5	5	5	5	19.5	97.5

The various food items such as cereals, pulses, vegetables, milk and milk products, fleshy foods were prepared in Avinash model cooker. All these food items scored more than 80 per cent. The highest score was awarded to sweet pongal, tomato rice, boiled green gram, cauliflower poriyal, bread payasam, chicken kurma, scrambled egg and egg omelet (97.5 per cent) followed by dhal rice, bengal gram sambar, potato masal, bitter gourd gravy and mutton curry (95 per cent).

2. Palatability of the foods cooked in Tulsi Gold solar cooker

The mean score awarded for the palatability of the foods cooked in Tulsi Gold cooker are illustrated in Table XIV

TABLE XIV

MEAN SCORE AWARDED FOR THE PALATABILITY OF THE FOODS COOKED IN TULSI GOLD SOLAR COOKER

S. No	Items cooked	Criteria				Total (20)	Perce -ntage
		Colour (5)	Taste (5)	Texture (5)	Appea -rance		
1.	Sweet pongal	4	5	5	5	19	95
2.	Ven pongal	4	3	4	5	16	80
3.	Noodles	5	4.5	4	5	18.5	92.5
4.	Tomato rice	5	4.5	5	5	19.5	97.5
5.	Dhal rice	4	4.5	5	5	18.5	92.5
6.	Peas sundal	4	4	4	4	16	80
7.	Boiled green gram	4.5	5	5	5	19.5	97.5
8.	Horse gram chutney	4	5	4	5	18	90
9.	Boiled channa	4	5	4	4	17	85
10.	Bengal gram sambar	4.5	5	4	5	18.5	92.5
11.	Beans poriyal	4	4	4	5	17	85
12.	Cauliflower poriyal	5	4.5	5	5	19.5	97.5
13.	Potato masal	4	4.5	4.5	5	18	90
14.	Bitter gourd gravy	5	4.5	4.5	5	19	95
15.	Brinjal gravy	4	4.5	4	5	17.5	87.5
16.	Carrot poriyal	5	4	4	5	18	90
17.	Coffee	4	4	5	4	17	85
18.	Tea	4	4	5	4	17	85
19.	Bread payasam	4.5	5	5	5	19.5	97.5
20.	Vermicelli payasam	4.5	5	4.5	4.5	18.5	92.5
21.	Chicken kurma	5	5	4.5	5	19.5	97.5
22.	Mutton curry	5	5	4.5	4.5	19	95
23.	Boiled egg	5	4	4	5	18	90
24.	Scrambled egg	4.5	5	5	5	19.5	97.5
25.	Egg omelet	4.5	4.5	5	5	19	95

All the food items prepared in Tulsi Gold solar cooker secured more than 80 per cent of score. Out of all the items scored, the highest score was awarded to tomato rice, boiled green gram, cauliflower poriyal, bread payasam, chicken kurma and scrambled egg (97.5 per cent) followed by sweet pongal, bittergourd gravy, mutton curry and egg omelet (95 per cent) and noodles, dhal rice, bengal gram sambar, vermicelli payasam (92.5 per cent).

3. Palatability of the foods cooked in Avinash model and Tulsi Gold solar cookers.

Table XV gives the mean score awarded for the palatability of the foods cooked in Avinash model and Tulsi Gold solar cookers.

TABLE XV

MEAN SCORE AWARDED FOR THE PALATABILITY OF THE FOODS COOKED IN AVINASH MODEL AND TULSI GOLD SOLAR COOKERS

S. No.	Items cooked	Percentage	
		Avinash	Tulsi Gold
1.	Sweet pongal	97.5	95
2.	Ven pongal	80	80
3.	Noodles	92.5	92.5
4.	Tomato rice	97.5	97.5
5.	Dhal rice	95	92.5
6.	Peas sundal	80	80
7.	Boiled green gram	97.5	97.5
8.	Horse gram chutney	90	90
9.	Boiled channa	85	85
10.	Bengal gram sambar	95	92.5
11.	Beans poriyal	87.5	85
12.	Cauliflower poriyal	97.5	97.5
13.	Potato masal	95	90
14.	Bitter gourd gravy	95	95
15.	Brinjal gravy	90	87.5
16.	Carrot poriyal	90	90
17.	Coffee	85	85
18.	Tea	85	85
19.	Bread payasam	97.5	97.5
20.	Vermicelli payasam	90	92.5
21.	Chicken kurma	97.5	97.5
22.	Mutton curry	95	95
23.	Boiled egg	90	90
24.	Scrambled egg	97.5	97.5
25.	Egg omelet	97.5	95

Among cereal preparations sweet pongal (97.5 per cent) dhal rice (95 per cent) cooked in Avinash model scored higher percentage compared to sweet pongal (95 per cent) and dhal rice (92.5 per cent) cooked in Tulsi Gold cooker. The other cereal items awarded equal score in both the cookers.

Various pulse preparations such as peas poriyal (80 per cent) boiled green gram (97.5 per cent), horse gram chutney (90 per cent) boiled channa (85 per cent) prepared in Avinash model and Tulsi Gold cookers awarded equal score.

Out of all the vegetable preparations beans poriyal (87.5 per cent) potato masal (95 per cent) and brinjal gravy (90 per cent) awarded 2.5 – 5 per cent more score in Avinash model cooker than Tulsi Gold cooker. The other preparations such as cauliflower poriyal (97.5 per cent) bitter gourd gravy (95 per cent) and carrot poriyal (90 per cent) secured equal score in both the cookers.

The milk and milk preparations such as coffee and tea (85 per cent) bread payasam (97.5 per cent) obtained equal score in both the cookers. Vermicelli payasam secured more score (92.5 per cent) in Tulsi Gold cooker compared to Avinash model (90 per cent).

With regard to the preparation of fleshy foods chicken kurma (97.5 per cent) mutton curry (95 per cent) boiled egg (90 per cent) and scrambled egg (97.5 per cent) obtained equal score in both the cookers,

Out of 25 items prepared in the selected Avinash and Tulsi Gold cookers Avinash cooker secured the maximum score for food items such as sweet pongal (97.5 per cent) dhal rice (95 per cent) bengal gram sambar (95 per cent), beans poriyal (87.5 per cent), potato masal (95 per cent) brinjal gravy (90 per cent) and egg omelet (97.5 per cent) compared to Tulsi Gold cooker.

The other 17 selected items awarded equal score in both the cookers except vermicelli payasam prepared in Tulsi Gold cooker secured 2.5 per cent more score than Avinash model cooker.

C. Evaluating the Physical Features of Avinash Model and Tulsi Gold Solar Cookers.

This aspect includes the following headings

1. Physical features of selected solar box cookers
2. Paper test
3. Weight and cost of the selected solar box cookers.

1. Physical features of selected solar box cookers

The physical features of selected solar box cookers as evaluated by selected panel of judges are shown in Table XVI and Figure10.

TABLE XVI

FEATURES OF SELECTED SOLAR BOX COOKERS

S. No.	Criteria	Avinash		Tulsi Gold	
		Yes	No	Yes	No
1.	Adequate size	84	16	88	12
2.	Convenient shape	80	20	84	16
3.	Durability of the materials used for its construction	96	4	92	8
4.	Comfortable height	80	20	80	20
5.	Less weight	32	68	60	40
6.	Easy mobility	44	56	68	32
7.	Acceptable price	76	24	70	30
8.	Ease of setting / handling	76	24	72	28
9.	Ease of cleaning / maintenance	80	20	64	36
10.	Easy to store	72	28	80	20

Eighty eight per cent of the judges felt that the size of the Tulsi Gold model was adequate for a family and 84 per cent of them were satisfied with the size of Avinash model.

More than eighty per cent of the judges expressed that the shape of Avinash and Tulsi Gold cookers were good. More than 90 per cent of the judges agreed that the materials used for the construction of the cookers were durable and of standard quality.

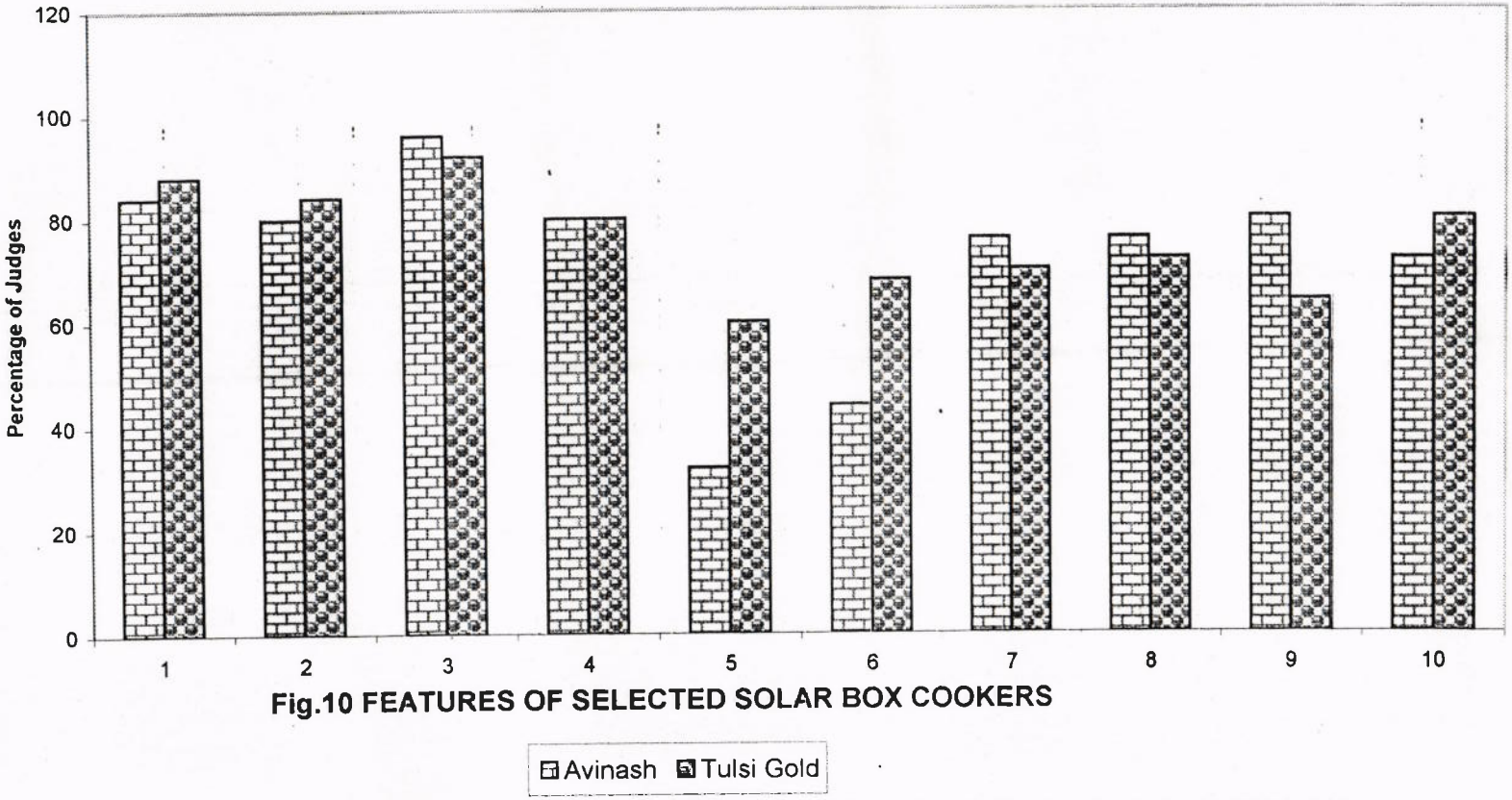


Fig.10 FEATURES OF SELECTED SOLAR BOX COOKERS

1.Adequate Size 2. Convenient Shape 3. Durability of theMaterials used for its Construction 4. Comfortable height 5. Less Weight 6. Easy Mobility 7. Acceptable Price 8. Ease of Settling/Handling 9. Ease of Cleaning/Maintenance 10. Easy to store

Eighty per cent of the judges felt that the height of both the cookers were ideal. Sixty per cent of them found that Tulsi Gold cooker is of light weight and only 32 per cent of them expressed that Avinash model cooker has less weight.

Sixty eight per cent of the judges mentioned that the Tulsi Gold cooker was easy to move from place to place and only 44 percent of them realised that Avinash model cooker was easy to mobile.

Seventy six per cent of the judges accepted the price of Avinash model cooker where as 70 per cent of them felt that the price of Tulsi Gold cooker was reasonable. Seventy six per cent of the judges realised that Avinash model cooker was easy to handle and 72 percent of them expressed that Tulsi Gold cooker was easy to handle.

Eighty per cent of the judges realised that the maintenance of Avinash model cooker was easy and only 64 per cent of them realised that the Tulsi Gold cooker was easy to maintain. More than 70 per cent of them found that both the cookers were easy to store.

2. Paper test

Paper test was the test conducted by the investigator to find out the airtightness of the solar cookers. First paper was kept in between the double glass lid and inner cooking box then the glass

lid was closed and paper was tried to take out. If the paper comes out freely without any difficulty then it will be considered that the cooker is not fabricated well, since it emits the heat outside freely. It was difficult to take the paper out from Avinash and Tulsi Gold cooker, so it is clear that both the cookers have more airtightness and heat retaining capacity.

3. Weight and cost of the selected solar box cookers.

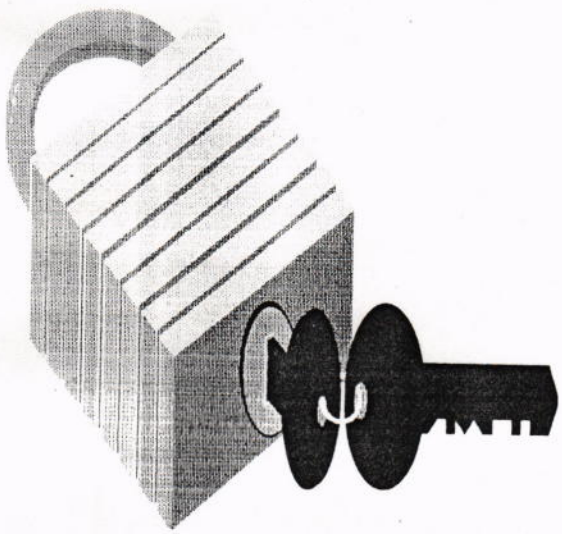
Table XVII represents the weight and cost of the selected solar box cookers.

TABLE XVII

WEIGHT AND COST OF THE SELECTED SOLAR BOX COOKERS

S. No.	Name of the cookers	Total weight in Kgms.	Total Cost in Rs.
1.	Avinash	12.50	2,500
2.	Tulsi Gold	12.15	3,000

The cost of the solar cooker depends upon the materials used for its construction, use of technology, size and shape of the cooker and facilities provided (electrical back up) in the cookers. The weight of Avinash model cooker is more (12.50 Kgms) when compared to Tulsi Gold cooker (12.15 kg). The cost of Tulsi Gold cooker is high (Rs. 3,000) whereas the cost of Avinash model is only Rs. 2,500. Avinash model cooker was locally manufactured, whereas Tulsi Gold was manufactured at Kanpur and transportation cost may also be the reason for increase in price of Tulsi Gold cooker.



SUMMARY & CONCLUSION

V SUMMARY AND CONCLUSION

We live in the most fascinating period in Indian history when developmental activities are being carried out all over the country to fulfill the vision of the Father of the nation, Mahatma Gandhi that new India should be developed several scientists have highlighted the relevance of alternate renewable sources of fuel for the developing countries. The sharp increase in oil prices, uncertainities in supplies, difficulties in production and transportation, decline of fossil fuels, degradation of the environment have led India to focus attention on renewable energy especially solar energy. Solar energy appears to be an appropriate option because of its non – polluting ecological nature, abundance availability at the point of use. Therefore it is the best and ready alternative to domestic fuel, if harnessed through solar cooking devices.

Solar cooker is a device which cooks food without using any conventional cooking fuel. It converts sunlight into heat energy and cooks the food. No smoke, no soot spoils our utensils, protects tree cover and keeps the environment clean are the advantages claimed by the solar cooker. Solar cooker carries the distinction of safety, simplicity and economy.

To analyse their worthiness in Indian context, a study has been designed to assess the performance of solar box cooker suitable for Indian households which can be readily available in the local markets. The Department of Family Resource Management of Avinashilingam Deemed University designed and developed a solar box cooker with the help of a local manufacturer of Filaments and Windings Private Ltd., Coimbatore in

order to promote the use of solar box cookers in the Indian households Eventhough there are lot of solar cooker manufacturers are available in the northern part and other parts of India, it is difficult to get the cookers from such far places.The solar cookers are not readily available in Coimbatore market like other household gadgets.

The main aim of fabricating Avinash model solar cooker was to make the cooker available in the local markets of Coimbatore. The earlier study proved that Tulsi Gold (Rohtas Electronics, Kanpur) is one of the best cookers available in the Family Resource Management Department. Thus the newly designed Avinash model Solar cooker was compared with Tulsi Gold cooker to find its efficiency.

The cooking experiments were conducted to find out the performance, time taken to cook various items and palatability of the foods cooked in both the cookers. Twenty five South Indian dishes were selected for conducting the experiments. The correlation between solar intensity and time taken to cook the various items were also statistically analysed . In addition physical features of both the cookers were evaluated by the selected panel of judges.

The Highlights of the study are summarised below:

1. Temperature recorded in Avinash and Tulsi Gold solar cookers

The temperature was recorded in both the cookers at two to three hours interval from 9.30am to 2.30pm for five days. The temperature observed was high in Avinash model cooker when compared to Tulsi Gold on all five days at all times with 2-3°C temperature difference. The

temperature recorded was high at 11.30am on all the days in Avinash (98°C) and Tulsi Gold (96°C) solar cookers. The temperature obtained in the cookers indicate that foods can be easily cooked in both the cookers.

2. Temperature recorded in Avinash model and Tulsi Gold cookers during cooking

The maximum temperature was recorded in Avinash model solar cooker when compared to Tulsi Gold cooker while cooking various selected food items except bitter gourd gravy. When there was a maximum solar radiation of 540 cal/cm^2 the cooking temperature observed in Avinash cooker was 98°C whereas in Tulsi Gold 96°C for preparing dhal rice. The highest cooking temperature 98°C was obtained in Avinash model cooker for various preparations such as tomato rice, dhal rice, boiled channa, potato masal, brinjal gravy, bread payasam and vermicellli payasam whereas Tulsi Gold cooker observed the maximum temperature of 96°C for dhal rice, potato masal and boiled channa irrespective of solar radiation.The difference in solar radiation and cooking temperature observed in the cookers may be due to the nature of food materials and the recipes used for preparation.

3. Temperature recorded while cooking in differrent vessels in Avinash model and Tulsi Gold solar cookers

Temperature was recorded while cooking foods in aluminium and stainless steel vessels in Avinash model and Tulsi Gold cookers. The maximum temperature was obtained in aluminium vessels compared to stainless steel for all the food preparations in both the cookers. There was a meagre difference of 2-4°C temperature was noted between aluminium and stainless steel vessels in both the cookers. The aluminium vessel recorded

more temperature compared to stainless steel vessel. It is a known fact that aluminium is a good conductor of heat. So maximum temperature was obtained and the foods cooked in aluminium vessel was faster than stainless steel vessel.

Comparing the temperature difference while cooking in aluminium and stainless steel vessels in both the cookers, Avinash model cooker recorded more temperature of 2-4°C than Tulsi Gold cooker.

4. Performance of solar cookers assessed in terms of time taken to cook the selected food items

Cereal preparations

It is noted that Avinash cooker seems to be an efficient cooker than Tulsi Gold since it took equal or less time to cook various items. The time taken to cook sweet pongal (90 minutes), tomato rice (100 minutes) and dhal rice (90 minutes) in both the cookers whereas for ven pongal and noodles preparations a meagre difference of 0-5 minutes extra time was taken by Tulsi Gold cooker.

Pulse preparations

Avinash model cooker took less time to prepare peas sundal (90 minutes) boiled green gram (80 minutes) horse gram chutney (90 minutes) and boiled channa (100 minutes) when compared to Tulsi Gold cooker, which took extra 5-10 minutes to prepare all these items. Bengal gram sambar preparation consumed equal time in both the cookers (90 minutes).

Vegetable preparations

For all the vegetable preparations Avinash model cooker needed less time compared to Tulsi Gold cooker, except bitter gourd gravy which took equal time in both the cookers. There was only 5-10 minutes extra time was required to cook various vegetable preparations in Tulsi Gold cooker.

Milk and milk preparations

The time required for milk preparations in Avinash model cooker was less compared to Tulsi Gold cooker. For bread payasam preparation the time consumed by Avinash model cooker was 25 minutes and in Tulsi Gold cooker 30 minutes. The maximum time 35 minutes was required to prepare vermicelli payasam in Avinash cooker and 40 minutes was consumed by Tulsi Gold cooker. Coffee and Tea preparations needed 30 minutes in Avinash cooker and 35 minutes in Tulsi Gold cooker. The time difference between the preparations reveal that it may be due to the texture of the products and the method of recipes used for the preparations.

Fleshy food preparations

Avinash model took less time compared to Tulsi Gold cooker to prepare all the fleshy food items. For preparing chicken kurma and mutton currry Avinash model required 120 minutes and 125 minutes respectively whereas Tulsi Gold needed extra 10 minutes for both the preparations. Boiled egg and scrambled egg took 20 minutes, egg omelet preparation needed 23 minutes in Avinash cooker. Tulsi Gold required extra 2-5 minutes for egg preparations.

Time taken, fuel spent and cost incurred on cooking food items using LPG

The various types of selected 25 food items required 20-125 minutes in Avinash model cooker whereas Tulsi gold consumed 23-135 minutes for the same. But using LPG needed only 4-45 minutes for preparing these items. The total cost incurred on preparing the selected food items is Rs. 30.36in LPG. The total amount of fuel spent for various food preparations is 2.392 kgms using LPG. Even though the time taken to cook the foods in solar cooker was more compared to LPG we could conserve a lot of fuel using solar cooker which needs only initial investment.

Palatability of the Foods Cooked in Avinash Model and Tulsi Gold Solar Cookers

Out of 25 items prepared in the Avinash and Tulsi Gold model solar cookers Avinash model cooker scored above 95 per cent for 13 food items such as sweet pongal, tomato rice, dhal rice, boiled green gram, bengal gram sambar, cauliflower poriyal, potato masal, bitter gourd gravy, bread payasam, chicken kurma, mutton curry, scrambled egg and egg omelet whereas Tulsi Gold scored above 95 per cent for 10 items such as sweet pongal, tomato rice, boiled green gram, cauliflower poriyal, bitter gourd gravy, bread payasam, chicken kurma, mutton curry, scrambled egg and egg omelet.

5. Features of Avinash model and Tulsi Gold solar cookers

Physical features

Eighty eight percent of the judges felt that the size of the Tulsi Gold model was adequate for a family and 84 per cent of them were satisfied with

the size of Avinash model. More than eighty per cent of the judges expressed that the shape of Avinash and Tulsi Gold cookers were good. More than 90 per cent of the judges agreed that the materials used for the construction of the cookers were durable and of standard quality. Eighty per cent of the judges felt that the height of both the cookers were ideal. Sixty per cent of them found that Tulsi Gold cooker is of light weight and only 32 per cent of them expressed that Avinash model cooker has less weight.

Sixty eight per cent of the judges mentioned that the Tulsi Gold cooker was easy to move from place to place and only 44 per cent of them realised that Avinash model cooker was easy to mobile. Seventy six per cent of the judges accepted the price of Avinash model cooker whereas 70 per cent of them felt that the price of Tulsi Gold cooker was reasonable. Seventy six per cent of the judges realised that Avinash model cooker was easy to handle and 72 percent of them expressed that Tulsi Gold cooker was easy to handle. Eighty per cent of the judges realised that the maintenance of Avinash model cooker was easy and only 64 per cent of them realised that the Tulsi Gold cooker was easy to maintain. More than 70 per cent of them found that both the cookers were easy to store.

Paper test

Paper test was the test conducted by the investigator to find out the air tightness of the solar cookers. First paper was kept in between the double glass lid and inner cooking box then the glass lid was closed and paper was tried to take out. If the paper comes out freely without any difficulty then it will be considered that the cooker is not fabricated well, since it emits the heat outside freely. It was difficult to take the paper out from Avinash and

Tulsi Gold cooker, so it is clear that both the cookers have more airtightness and heat retaining capacity.

Weight and cost of the selected solar box cookers

The cost of Tulsi Gold cooker is high (Rs. 3,000) whereas the cost of Avinash model is only Rs. 2,500. The weight of Avinash model cooker is more (12.5 kgms.) when compared to Tulsi Gold cooker (12.15 kg).

CONCLUSION

Performance study of Avinash model cooker revealed that it is an efficient cooker when compared to Tulsi Gold cooker in terms of time taken and palatability of the foods cooked in it. Family Resource Management department of Avinashilingam Deemed University, Coimbatore has got an ISI approval from MNES for Avinash model cooker. In the future this model cooker will be readily available in the local markets of coimbatore in order to enhance the feasibility of the use of best model cooker in everyday cooking.

RECOMMENDATIONS

1. Research organisations should manufacture the best model solar box cooker suited for Indian households
2. People should be made aware of various agencies promoting solar box cookers
3. Government should give subsidy to all the manufacturers of solar box cookers to manufacture the low cost solar cookers
4. Universities and colleges should create awareness on the use of solar cookers through NSS and departmental research programmes

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APPENDICES

FOOD ITEMS

RECIPES

1. Sweet Pongal

Ingredients	Quantity (gms)
Rice	150
Jaggery	150
Ghee	50
Raisins	10
Cashew Nuts	10
Green Gram dhal	100

Method:

- Boil the water then add rice and green gram dhal and when the cooking process is going to be finished add jaggery and allow it for cooking
- Finally add fried raisins and cashew nuts.

2. Ven Pongal

Ingredients	Quantity in gms
Rice	150 gms
Green gram dhal	100 gms
Pepper	50 gms
Ghee	50 gms
Salt	to taste

Method:

- Boil the water then add rice, green gram dhal and pepper
- Heat the ghee in a pan and add cooked rice into it.

3 . Noodles

Ingredients	Quantity
Noodles	100 gms
Masala powder	25 gms
Big onion	1 no.
Tomato	1 gm
Oil	2 tsp
Salt	to taste

Method:

- Break the noodles into pieces
- Heat oil thoroughly in a vessel and add the onion, tomato and salt
- Add enough water and put the noodles into the pan and allow it to cook.

4. Tomato Rice

Ingredients	Quantity
Biriyani rice	200 gms
Tomato	100 gms
Big onion	1 no.
Green chillies	3 nos.
Coriander leaves	5 gms
Oil	3 tsp
Ghee	4 tsp
Salt	to taste
For Paste:	
Garlic	10 gms
Ginger	10 gms
Cinnamon	5 gms
Cloves	1 no.

Method:

- Chop the onion finely
- Cut the tomatoes into small cubes
- Heat oil in a vessel, add the paste and onion then the tomatoes
- Add the rice and pour 400ml of water into it
- Add salt to taste
- When the rice is almost cooked add little amount of curd and mix it cover and cook for few minutes
- Before serving add ghee and sprinkle the chopped corriander leaves.

5. Dhal Rice

Ingredients	Quantity
Rice	150 gms
Red gram dhal	50 gms
Tomato	2 nos.
Big onion	1 no.
Green chillies	5 nos.
Oil	3 tsp
Ginger	10 gms
Garlic	10 gms
Cinnamon	10 gms
Salt	to taste

Method:

- Heat the oil in a vessel and fry the onions and tomato for 2 minutes
- Add the paste and leave for atleast 2 to 3 minutes
- Add adequate water to it
- When the water starts to boil add rice, dhal and salt and allow it for cooking.

6. Peas Sundal

Ingredients	Quantity
Peas Sundal	100 gms
Oil	2 tsp
Onion	50 gms
Greenchillies	10 gms
Mustard	½ tsp
Salt	to taste

Method:

- Soak the peas sundal for 6 hrs
- Boil the soaked peas
- Heat oil in a pan, add onion, green chillies, mustard, salt and boiled peas sundal.

10. Boiled channa

Ingredients	Quantity
Channa	100 gms
Large onion	1 no.
Green chillies	2 nos.
Grated coconut	½ cup
Oil	2 tsp
Mustard	½ tsp
Salt	to taste

Method:

- ♣ Soak the channa for 6 hours and boil it well
- ♣ Heat oil in a pan, add mustard, fry the onion and green chillies
- ♣ Finally add boiled channa, grated coconut and salt.

11. Beans poriyal

Ingredients	Quantity
Beans	150 gms
Oil	2 tsp
Onion	50 gms
Green chillies	10 gms
Mustard	½ tsp
Grated coconut	100 gms

Method:

- Heat the oil in a pan, add mustard, onion, green chillies and beans
- After cooking was over, add grated coconut and salt to it.

12. Cauliflower poriyal

Ingredients	Quantity
Cauliflower	150 gms
Onion	50 gms
Green chillies	10 gms
Oil	2 tsp
Curry leaves	10 gms
Mustard	½ tsp
Turmeric & Chilli Powder	1 tsp
Tomato	1 no.
Salt	to taste

Method:

- Boil the cauliflower with little amount of salt
- Heat the oil in a pan, add mustard, onion, green chillies, curry leaves and Tomato
- Add boiled cauliflower and sprinkle turmeric and chilli powder and allow it for frying for 5 minutes.

13. Potato podimas

Ingredients	Quantity
Potato	100 gms
Small onion	5 nos.
Oil	2 tsp
Mustard	½ tsp
Turmeric powder	½ tsp
Green chillies	2 nos.
Curry leaves	5 gms
Salt	to taste

Method:

- Boil the potatoes and peel the skin
- Mash it well
- Heat the oil in a pan, add mustard, onion, chillies and curry leaves, turmeric powder
- Add the mashed potato into it, add salt and mix well.

14. Bittergourd gravy

Ingredients	Quantity
Bittergourd	100 gms
Tamarind	50 gms
Sugar	1 tsp
Oil	2 tsp
Mustard	¼ tsp
Small onion	10 nos.
Red chillies	3 nos.
Curry leaves	5 gms
Salt	to taste

Method:

- Cut the bittergourd into small cubes
- Heat the oil in a pan, add mustard, onion, chillies, curry leaves
- Add bittergourd, chilli powder and turmeric powder
- Add tamarind pulp and salt
- Allow it for cooking
- Finally add sugar to it.

15. Brinjal gravy

Ingredients	Quantity
Brinjal	150 gms
Coriander powder	50 gms
Onion	10 nos.
Green chillies	2 nos.
Grated coconut	¼ cup
Oil	2 tsp
Mustard	¼ tsp
Red chillies	2 nos.
Curry leaves	5 gms
Salt	to taste

Method:

- Add grated coconut, coriander powder, red chillies and onion. Grind it into a paste
- Add brinjals into the paste and allow it for cooking
- Heat the oil in a pan, add mustard, green chillies, onion, curry leaves and add cooked brinjal coriander mix with salt.

16. Carrot poriyal

Ingredients	Quantity
Carrot	150 gms
Oil	2 tsp
Onion	50 gms
Green chillies	10 gms
Mustard	½ tsp
Salt	to taste

Method:

- Heat the oil in a pan, add mustard, onion, green chillies, carrot and salt
- Put it in a solar cooker vessel and allow it for cooking.

17. Coffee

Ingredients	Quantity
Coffee powder	50 gms
Milk	200 ml
Sugar	100 gms

Method:

- Boil water and add coffee powder and milk
- Add sugar to it and strain it.

18. Tea

Ingredients	Quantity
Tea powder	50 gms
Milk	100 ml
Sugar	100 gms

Method:

- Boil the water and add tea powder and milk
- Add sugar and strain it.

19. Bread payasam

Ingredients	Quantity
Bread	3 slices
Ghee	3 tsp
Sugar	150 gms
Cashew nuts & Raisins	10 gms
Milk	100 ml

Method:

- Heat the ghee in a pan, add bread pieces and fry it until goldenbrown colour
- Boil the water in a pan, add bread pieces
- When it becomes semisolid consistency, add sugar and mix it well
- Add fried cashew nuts and raisins
- When it is ready add milk and serve.

20. Vermicelli payasam

Ingredients	Quantity
Vermicelli	100 gms
Milk	100 ml
Sugar	150 gms
Ghee	10 gms
Raisins & Cashew nuts	10 gms

Method:

- Boil the water and add vermicelli into it
- While the cooking process is over add sugar and milk
- Fry the raisins and cashew nuts in ghee and add it into the cooked vermicelli.

21. Chicken kurma

Ingredients	Quantity
Chicken	200 gms
Big onion	3 nos.
Tomato	2 nos.
Turmeric	½ tsp
Chilli powder	1 tsp
Oil	5 tsp
Red chillies	3 nos.
Ginger & garlic	10 gms

Method:

- Heat the oil in a pan add mustard, onion, red chillies, tomato and giner garlic paste
- Add chicken pieces, turmeric powder and chilli powder, salt

22. Mutton curry

Ingredients	Quantity
Mutton	200 gms
Coriander	25 gms
Small onion	5 nos.
Red chillies	2 nos.
Grated coconut	¼ cup
Oil	2 tsp
Mustard	¼ tsp
Green chillies	2 nos.
Onion	5 nos.
Curry leaves	5 gms
Salt	to taste

Method:

- Add grated coconut, coriander powder, red chillies, small onion, turmeric powder and grind into a fine paste
- Add mutton to the paste and allow it for cooking
- Heat the oil in a pan add mustard, onion, green chillies, curryleaves and add well cooked mutton gravy and salt.

23. Boiled egg

Ingredients	Quantity
Egg	2 nos.

Method:

- Boil the water and put the egg into it and allow it for cooking.

24. Scrambled egg

Ingredients	Quantity
Egg	2 nos.
Grated coconut	50 gms
Coriander leaves	10 gms
Green chillies	5 gms
Small onion	10 gms
Salt	to taste

Method:

- Mix all the above ingredients
- Allow it for cooking.

25. Egg omelet

Ingredients	Quantity
Egg	3 nos.
Small onion	5 nos.
Green chillies	2 nos.
Pepper	5 nos.
Oil	10 tsp

Method:

- Heat the oil in a pan add onion, chillies, pepper, salt and fry well
- Beat the egg nicely and add the fried onion and mix well
- Apply oil in the pan and pour the egg, onion mix and allow it for cooking.

APPENDIX II

SCORE CARD

Name of the recipe

S. No.	Criteria	Grade	Score
1.	Colour	Excellent	5
		Very good	4
		Good	3
		Fair	2
		Poor	1
2.	Taste	Excellent	5
		Very good	4
		Good	3
		Fair	2
		Poor	1
3.	Texture	Excellent	5
		Very good	4
		Good	3
		Fair	2
		Poor	1
4.	Appearance	Excellent	5
		Very good	4
		Good	3
		Fair	2
		Poor	1

APPENDIX III

CHECK LIST

Name of the cooker

S. No.	Criteria	Yes	No
1.	Adequate size		
2.	Convenient shape		
3.	Durability of the materials used for its construction		
4.	Comfortable height		
5.	Less weight		
6.	Easy mobility		
7.	Acceptable price		
8.	Ease of setting/ handling		
9.	Ease of cleaning/ maintenance		
10.	Easy to store		

APPENDIX IV

STATISTICAL ANALYSIS OF CORRELATION VALUE BETWEEN SOLAR RADIATION AND COOKING TIME IN SELECTED SOLAR BOX COOKERS

Correlations:	Avinash	Tulsi Gold
Radiation	-.2834	-.1403
	(25)	(25)
	ρ= .282	.514