A REVIEW ON PRESENT SOLAR BOX TYPE COOKER

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ABSTRACT

A lot of research work has been carried out in recent few years in the world which shows that the utilization of solar energy towards the greatest need of humankind obviously solar cooking. The fuel saving, non-polluting environment, saving of electricity, higher nutritional value of food are the some of the major advantages of cooking with solar energy. Conventional box type solar cooker faces a problem with lower efficiency and cooking only during the sunshine hours. Hence, it is necessary to enhance the performance of box type solar cooker. The Present paper reviews the various techniques to increase duration for the cooking i.e. cooking during off-shine hours and enhance the performance of box type solar cooker.

Keyword: *SBC (Solar Box Type Cooker), Solar cooking*

1. INTRODUCTION

Energy has been globally accepted as one of the most significant input for human and economic development. According to International Energy Agency 80% of the present world energy use is based on the fossil fuels. The consumption of fossil fuel increases day by day but availability of fossil fuel is limited, which will leads towards the energy crisis. The combustion of the fossil fuel causes a harmful emission which affects the environment, human and animal life. Hence, need for the eco-friendly source of energy which can for eliminate the energy crisis. A solar energy is the most promising alternative source of energy which can solve the energy crisis problem.

Cooking a food using solar energy is one of the promising and beneficially system, which can reduces the cooking fuel expense up to 60%. Solar cooking also reduces the harmful effect produced by the fossil fuel. Higher nutritional value of food can be obtained using solar cooking in compared to conventional cooking. According to the principle of solar cooking, 20% of heat is spent in bringing food to boiling temperature, 35% of heat is spent in vaporization of water and 45% of heat is spent in convection losses from cooking vessels. So that, if reduction in convection heat losses occur from cooking vessel leads to increase in performance of the box type solar cooker. Thus, in this paper, various techniques are discussed to increase the performance of box type solar cooker.

2. LITERATURE REVIEW

Mullick *et al.* (1987) [1] have developed the evaluation methodology for the solar cookers by the first figure of merit (F_1) and the second figure of merit (F_2). The atmosphere change does not affect the parameters of solar cooker. The higher value of F_1 shows that the good optical efficiency and low heat loss factor. The higher value of F_2 shows that heat exchange efficiency factor F_i', correct optical efficiency ηo, and low heat capacity of the solar cooker. They plot the characteristic curve of τ_{boil} versus $(100 - T_a)/H$. The boiling time is linear function of atmospheric changes.

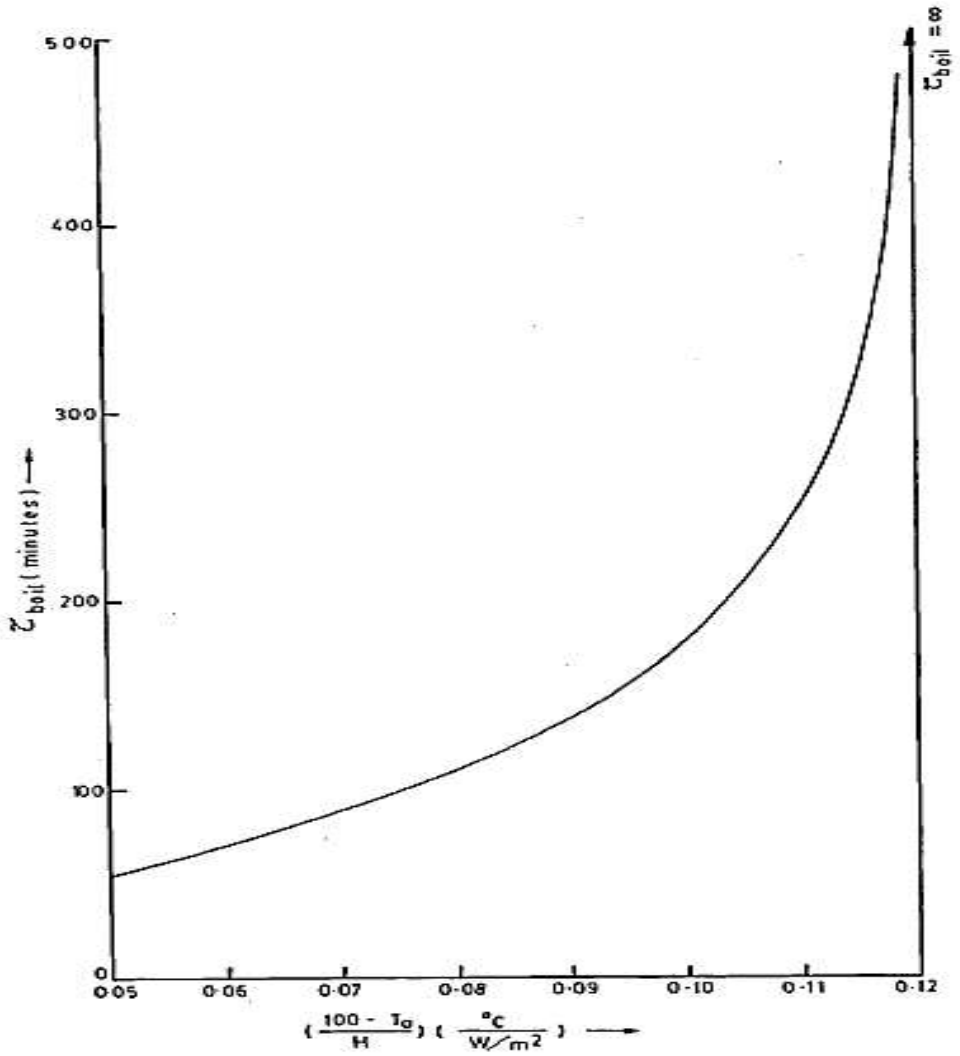
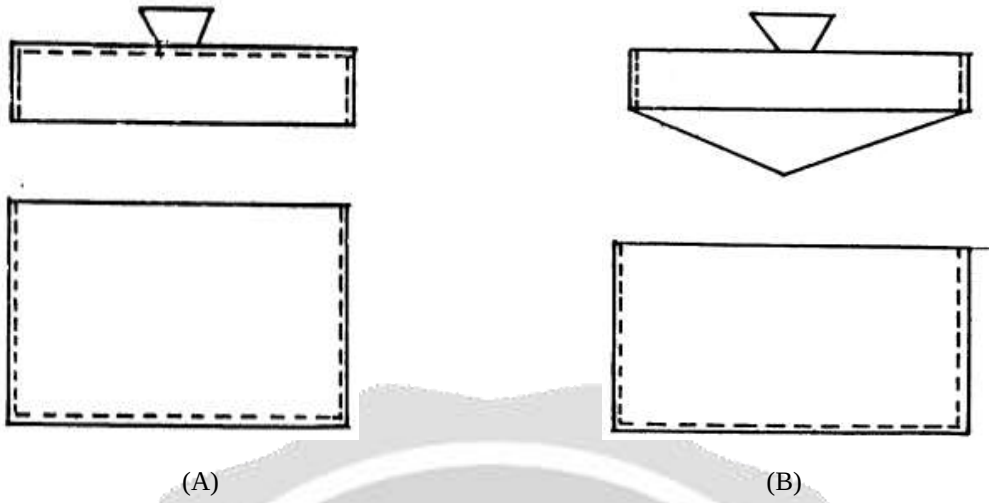


Fig.1: Characteristic curve of a solar cooker [1**]**

Gaur *et al.* (1999) [2] have developed the utensil with modified concave shape lid instead of plain shape lid as shown in Fig. 2 (A) and (B). They have carried out the experimental comparison of box type solar cooker with plain lid utensil and with the concave shape lid utensil. From the experiment, they have obtained 3-7°C higher temperature with concave shape lid utensil in compare to the plain shape lid utensil as shown in Fig. 3. From the water heating test, they showed that the concave shape lid utensil took 10-13% less time than the plain shape lid utensil. Hence, the cooking time was reduced with concave shape lid utensil and increasing the overall efficiency of cooker.



(A) (B)

Fig.2: (A) Conventional lid utensil and (B) Concave lid utensil [2]

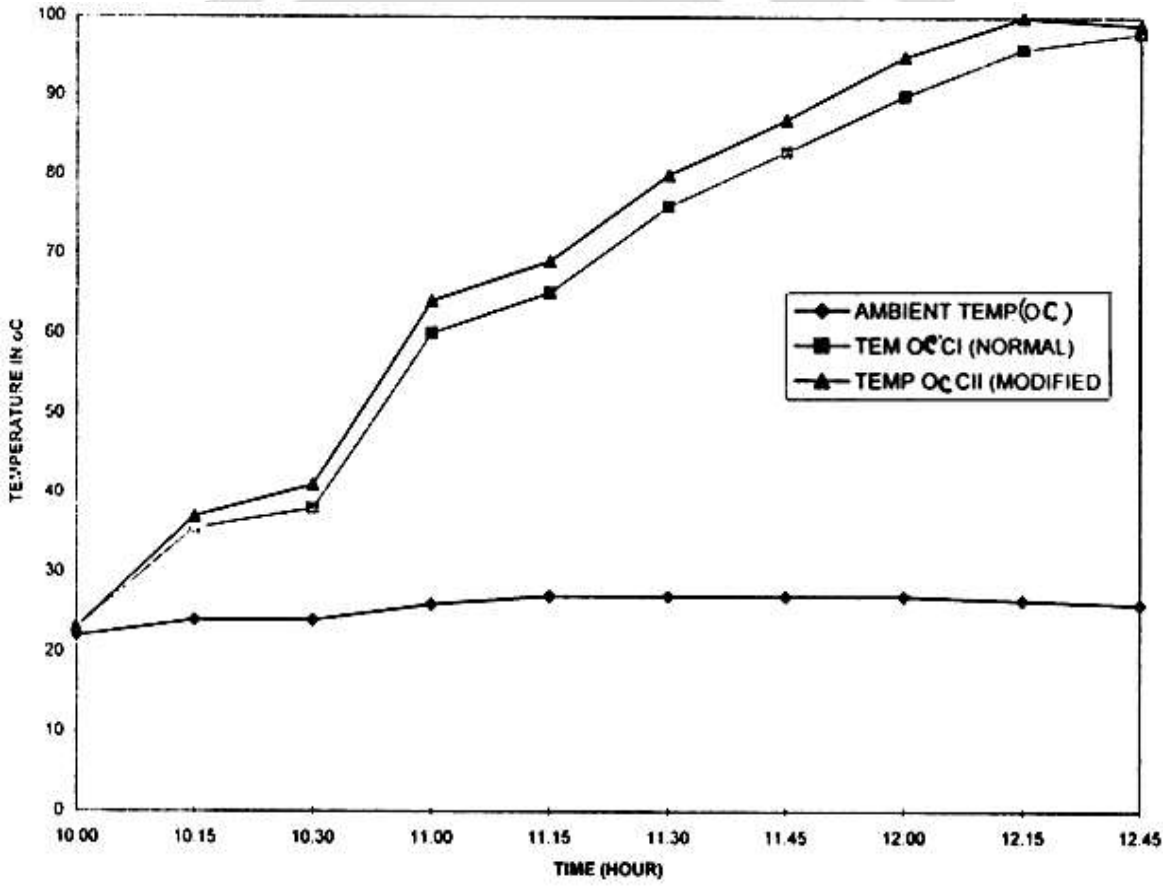


Fig.3: Comparison of water heating test with plain and concave lid utensil [2]

A.V. Narasimha Rao *et al.* (2003) [3] have modify the heat transfer process towards the food, for that they have raised the vessel by furnishing a few lugs as shown in Fig. 4. The lugs were made of mild steel having a 7 mm thickness. The lugs provide the heat transfer surface to the base of the vessel. They proved that the modification improves the performance of the cooker by improving the rate of heat transfer in both heating and cooling modes. They found reduction in time to reach saturation temperature and cooking of food. They have also carried out the

comparative experimental analysis whose results shown in Fig. 5 and found that the 3-5 °C more temperature achieved when vessel put on the lugs.

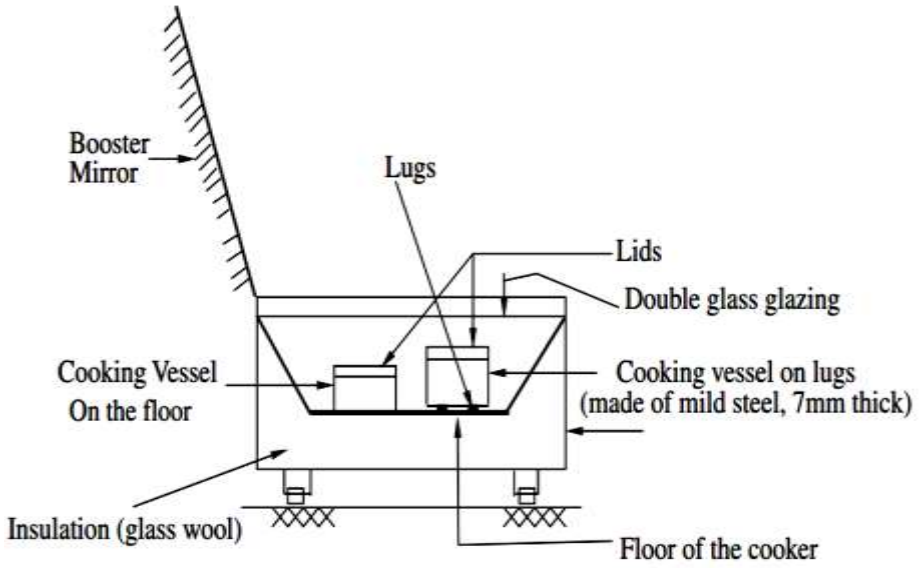


Fig.4: Box type solar cooker with a cooking vessel on lugs and conventional cooking vessel [3]

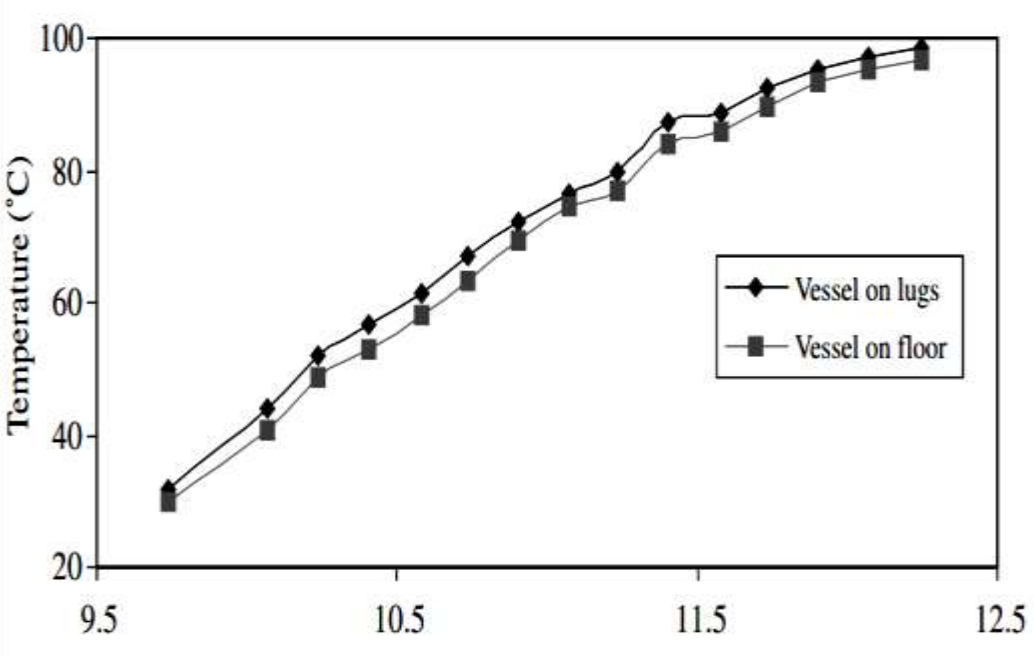


Fig.5: Temperature comparison of vessel on lugs and floor [3]

N. M. Nahar *et al.* (2003) [4] used engine oil as an energy storage material in the solar cooker, so that cooking can be performed in the late evening. They have carried out comparative experimental testing of a solar cooker by measuring stagnation temperatures with and without using of engine oil. They were obtained 23 °C more temperature in solar cooker with storage in compare to ordinary solar cooker during the off-shine hours, as shown in Fig. 6. They obtained the efficiency of the hot box storage solar cooker around 27.5%.

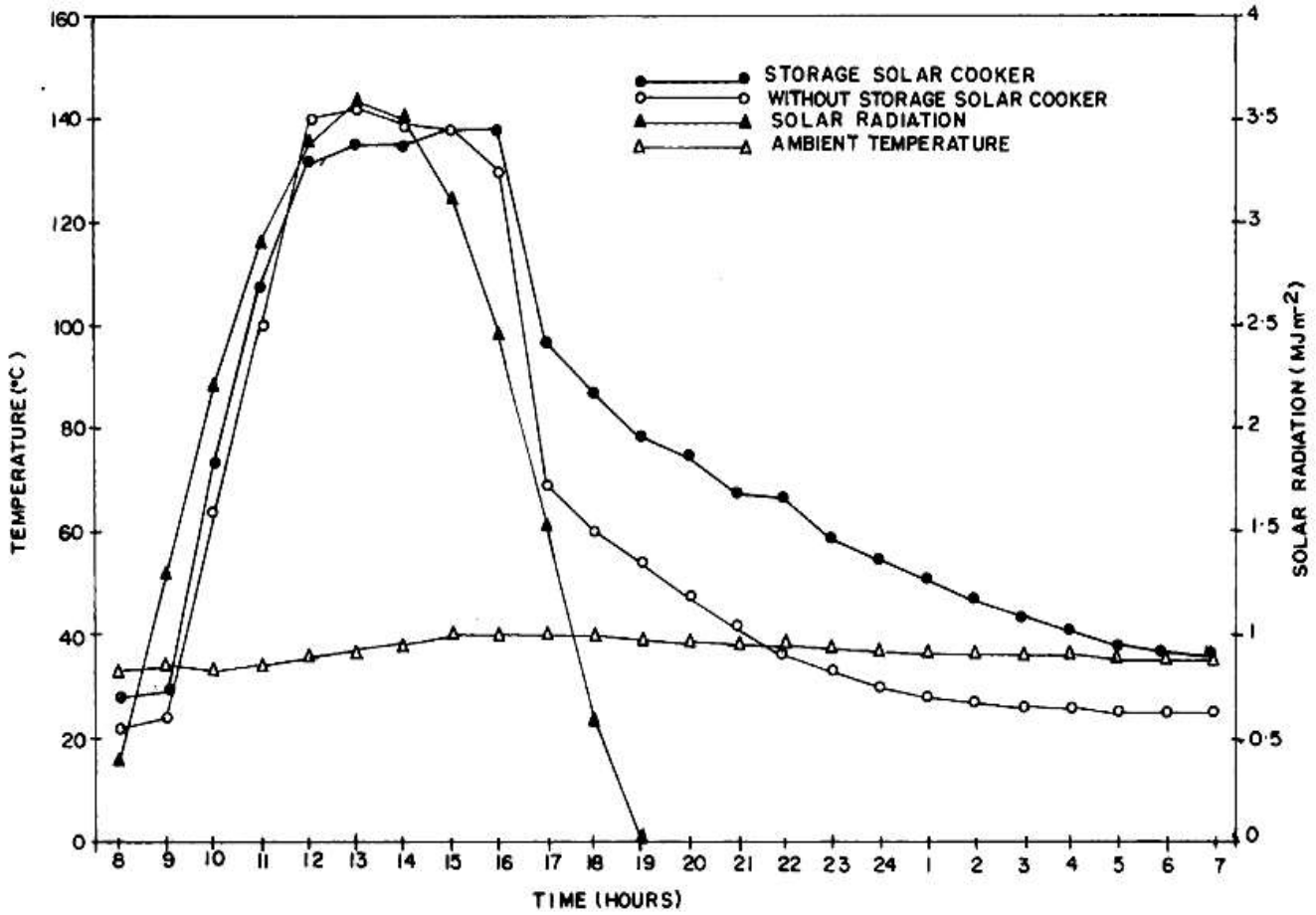


Fig.6: Stagnation temperatures test of hot box solar cookers with and without storage material [4]

Arezki Harmim *et al.* (2008) [5] have developed the finned type cooking vessel as shown in Fig. 7, and carried out the experimental comparison with conventional cooking vessel. From experimental comparison, they observed that more heat transfer takes place towards the food in the finned type vessel. Hence, the cooking time reduced and better cooking action can be took placed. Fig. 8 shows the temperature achieved by finned vessel and conventional vessel with time. From the Fig. 8, one can observed that temperature achieved by the finned vessel is 5-7 °C more than the temperature achieved by conventional vessel.

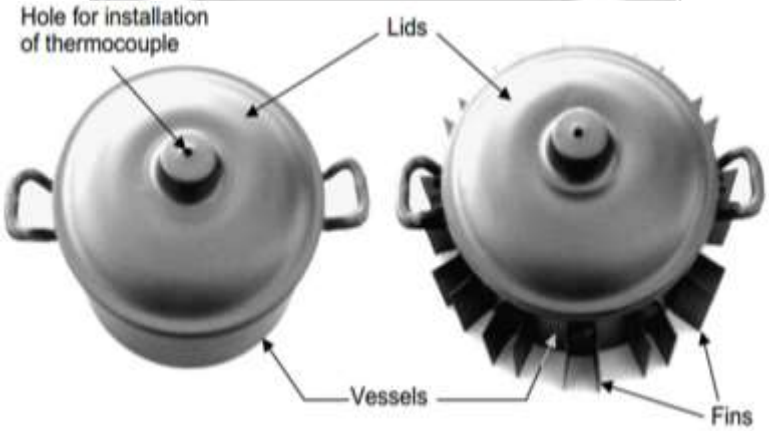


Fig.7: Conventional and finned vessel [5]

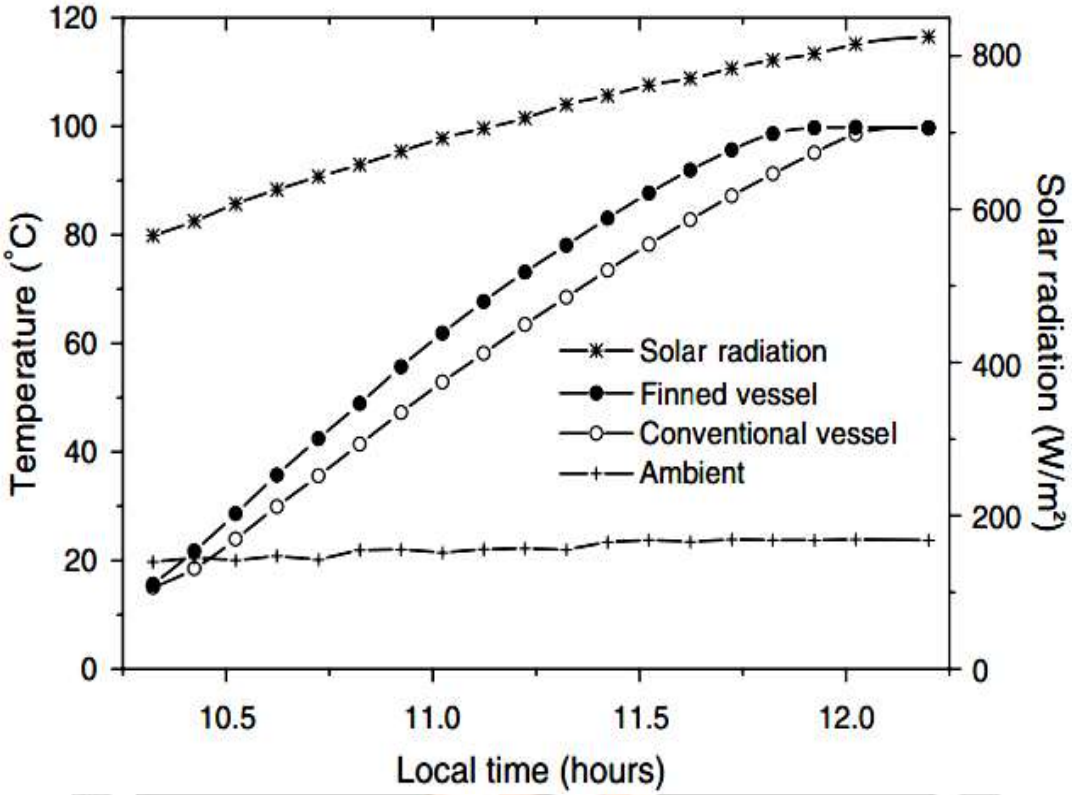


Fig.8: Comparison of water heating test with finned and conventional vessel [5]

A Harmim *et al.* (2012) [6] have fabricated prototype of solar box type cooker integrated with an asymmetric Compound Parabolic Concentrator (CPC) and conducted experiment under the climatic condition of Adrar located in Algerian Sahara.

Fig.9. Prototype of fabricated solar cooker [6]

They have performed an experimental evaluation with newly developed solar cooker with compound parabolic concentrator and calculated the value of first figure of merit and second figure of merit as 0.16810 and 0.350 respectively, higher than the conventional solar cooker.

S.B. Joshi *et al.* (2015) [7] made novel attempt and designed a prototype of improved small scale box type hybrid solar cooker (ISSBH) for small family as shown in Fig. 10. The solar panels designed for 75 W output, consisting of five solar panels 15 W each is an integral part of the SSBH and ISSBH solar cookers. They have utilized the heaters, operated on the output of the solar panel, inside the solar cooker for heating the food. By using such kind of the technology, they reduced the cooking time of the food. They were found that with the ISSBH, four to five meals can be prepared in a day within the affordable cost. The efficiency obtained was 38% for ISSBH.

Fig.10: Small Scale Box Type Hybrid Solar Cooker (SSBH) [7]

3. CONCLUSIONS

The present review paper includes the various techniques to reduce the cooking time and to improve the efficiency of box type solar cooker. It is conclude that,

1. The heat transfer can be increased towards the food place inside the vessel by the modification on the cooking vessel like, concave shape lid and finned cooking vessel.
2. Heat transfer towards the food can be increased by utilizing the lugs for putting the cooking vessel so that the base of vessel can acts as a heat transfer surface.
3. Thermal energy storage material can be used in box type solar cooker. So, that the effective cooking can be possible during the off-shine hours.
4. Solar panel can be used to operate heaters which can be placed inside the cooker so that the additional heating action can be provided for the faster cooking.

4. REFERENCES

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