

Review Article

Utilization of solar energy for preparation of Ayurvedic formulation

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ABSTRACT:

This article deals with a current revolutionary trend that is the use of alternative energy resources, keeping in mind the long term prospects for humanity. Our planet is directly or indirectly run by the energy of the sun. And the sun is continuously showering the planet with abundant energy. Instead of using energy in some other form if we can use the sun's energy by directly collecting it. Various nonconventional energies that are used currently include wind energy, geothermal heat energy, biomass energy, tide energy, and solar energy, etc. Coming to the use of non-conventional energy resources in the field of preparation of Ayurvedic medicines solar energy can be the best option. There is extensive research that has been done on solar energy for cooking, for electricity, industrial processes, etc. and it has been successful to a larger extent even though there are few major challenges that have to be tackled while dealing with solar energy. In this article heating requirements for the preparation of Ayurvedic medicine with solar energy are addressed and how we can deal with various types of heatings (*Agnis*) described by *Acharyas* is discussed. Also, various types of solar cooker designs are discussed that are used for different purposes but also can be used for Ayurvedic medicines. An innovative solution is proposed to adopt the technology for the preparation of Ayurvedic medicines.

KEY WORDS: *Agni, Swarasa, Hima, Phanta, Sneha kalpana*

INTRODUCTION:

There are three types of *Agni* (Fire) stated in ancient text of Ayurveda viz., *Avyakta Agni* (Nature form of *Agni*), *Vyakta Agni* (Fire)^[1]. In *Avyakta Agni*, actual fire is not present, but it attains a specific temperature which is sufficient to complete the process of formulation e.g. fermentation process is carried out in an isothermal environment (*Samasheeta ushana Gruha, Bhugarbha ushma*)^[2]. In *Vyakta Agni*, actual fire is present eg. For *Kupipakva Rasayan*, for *Kwath* (Decoction) preparation *Agni* is used. For *Vyakta Agni* mostly firewood, cow's dungs, LPG gas, and other energy source are used as fuel. Rasashastra and Bhaishajya Kalpana is a branch of Ayurveda which deals with the study of the preparation of various Ayurvedic herbal or herbo-mineral formulations. There are two types of energy i.e. renewable and non-renewable. Renewable energy sources are solar energy, wind energy, etc. and non-

renewable energy sources are petroleum oil, wood, coal, etc. As non-renewable source has more side effects on the environment so the renewable source is not hazardous to the environment also it is available free of cost. So, we have to use renewable energy i.e. solar energy, wind energy. Nothing is cheaper than free of cost. But solar energy is available in an abundant amount in nature free of cost.

Aim and Objective:

1. To review *Agni* in Ayurveda
2. To review the utilization of solar energy.

Materials and Methods:

***Agni* in Ayurveda:**

Ayurved is the Indian traditional system of medicine that uses herbal, animal products, some specious

stones, certain poisonous herbs, minerals that originated medicament for the treatment of the disease. So, this *Dravays* (Herbals or Minerals) are not used directly because of it contains some impurities, poisonous elements, *Rasa* (Taste), hardness, etc. *Acharya Charaka* quoted " *Sansakaro hi nam Gunantaradhan*" in *Viman Sthan*, which means because of the process on herbal drug or herbo-mineral drugs the *Gunvardhana* (Increase potency) occurs [3]. Hence some *Sansakar* has done on *Dravya*, so it can be used as *Ahara* or *Aushadhi Dravya*. For this *Sansakara Agni* is used.

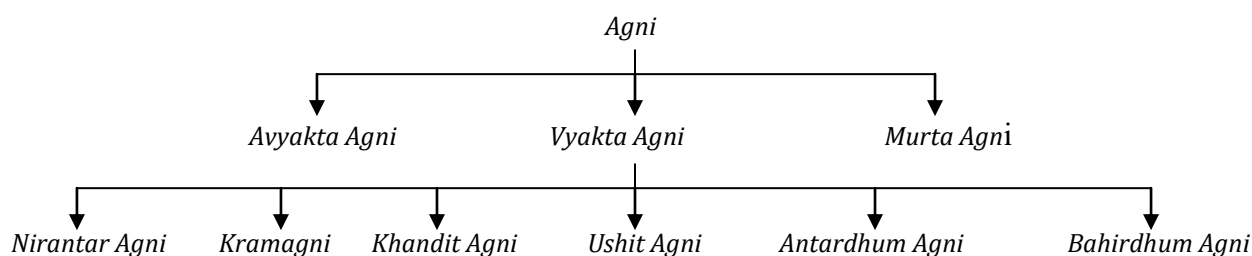
Types of Agni:

1. According to Arka Praksh^[4]:

1. *Dhumagni*
2. *Mandagni*
3. *Deepagni*
4. *Madhyam Agni*
5. *Kharaagni*
6. *Bhatagni*

2. According to Dhamankar Shastri^[1]:

Chart No. 01: Types of Agni according to Dhamankar Shastri



1. Avyakta Agni:

In this type of *Agni* actual fire is not present, but a sufficient amount of temperature present which use for the preparation of formulations. It's a *natura Agni*.

2. Vyakta Agni:

In this type of *Agni* actual fire is present. In this *Agni* different types of fuel are uses for example cow dungs, LPG gas, firewood, coal, etc.

In *Bhaishajya Kalpana Agni* is required for the preparation of *Swarasa* (Juice), *Kwath* (Decoction), *Hima*, *Phanta*, *Avaleha Kalpana* (Linctus), *Gutika Kalpana* (Tablets), *Arka Kalpana* (Distillation Formulation), *Pathya Kalpana*, etc. In *Rasashastra Agni* is require for *Rasa dravya Shodhana* (purification), *Marana* and *Amrutikarana* (incineration) process. For the preparation of Ayurvedic formulations both types of *Agni* are used. As Ayurveda is an ancient science at that time there is not any temperature measuring instrument, so *Acharyas* are explained the number of ingredients, amount of fuel, and time for preparation of formulations. In some formulations, specific fuel is explained eg. For *Putta* cow dungs used as fuel^[5], For *Satvapathanarth* (Extract of metal alloy) *Vasha*, *Khadir*, *Madhuk*, *Badar*, *Daru Haridra* wood are used^[6]. In some formulations, fuel is not explained, but the

type of *Agni* and time are explained. In that formulations, firewood, coal, LPG gas are used till *Siddhi Lakashana* appears e.g For *Sneha kalpana* (Medicated oil or *ghruta*), *Hima*, *Phanta*, *Mand*, *Peya*, *Vilepi* etc. Solar energy is used today in many ways like heating, cooking, drying, to generate electricity. A solar cooker is a device which use to convert solar energy to heat energy that can use for cooking^[7].

Solar Energy:

India lies between latitude 7° and 37° N and receives an annual average intensity of solar radiation between 400 to 700 cal/cm²/day^[3]. The daily solar isolation figures over the different places in India are accurately available. Peak values are generally measured in April or May, with parts of Rajasthan and Gujarat receiving over 600 cal/cm²/day. During the monsoon and winter months, daily solar radiation decreases to about 400 cal/cm²/day.

Solar cooker:

a) History^[8]:

The first academic description of the principle of the solar cooker was explained by Swiss geologist, meteorologist, physicist, mountaineer, and Alpine explorer *Horace Benedict de Saussure* in 1767.

b) Three main principles of solar cooking:**1. Concentration (reflection, or reflectance):**

The concentration of the sun's rays is performed most often by reflecting panels, petals, and such surfaces that can "focus" or concentrate the rays of light (UV) to a point or concentration. These reflecting panels are usually made of materials that are shiny and reflective due to the substance used in their manufactures, such as silver, chromium, and aluminum. A mirrored surface with high specular reflection ($\theta_i = \theta_r$) is used to concentrate sunlight into a small cooking area.

2. Absorption (ability to attract or hold heat):

Absorption of the sun's energy (heat) in solar cooking is best achieved when a surface is dark in color, thus the most common solar oven interiors are usually black in color as well as the color of the cookware used for cooking the food. Here solar cooker concentration sunlight on receiver such as solar pan. After concentration light energy converts into heat energy by conduction mechanism. This conversion is maximized by using material that conducts and retains heat.

3. Retention (means or capacity to retain heat):

Retention is the final principle in solar cooking. If a solar cooker is not well insulated and if it does not have a cover or lid, then all of the concentrated heat (energy) and all of the absorbed heat would quickly dissipate into the air and be lost to the surrounding environment.

Advantages:

1. No pollution
2. No smoke formation
3. No use of any fuel
4. Solar energy available every day.
5. The maintainsnce free and long-lasting.

Disadvantages:

1. More time is required.
2. Initial cost is high.
3. Solar cooker is large and bulky to carry
4. Effect of cloudy weather

c) Types:

1. Solar box cooker
2. Solar panel cooker
3. Parabolic solar cooker

4. Paraboloidal Reflector
5. Scheffler solar cooker
6. Tube solar oven

1. Box type solar cooker:

A box type solar cooker has a transparent glass or plastic top and may have an additional reflector (eg foil-lined or shiny metal) which concentrate sunlight in the box. The cooking container should be dark in color or black. Flat black, spray paint, black tempera paint is usually used which are non-toxic in nature. The box should have insulated inside. The solar box able to achieve temperature up to 150°C.

Advantages:

1. It is very simple, easy to use, and also safe.
2. It is very easy to construct.
3. It does not require continually stand beside the solar cooker during the preparation period.

Disadvantages:

1. Because of expecting temperature is low achieve by box solar, it takes time for preparation of formulation.

2. The panel solar cooker:

The panel solar cooker has reflective panels to direct sunlight to a cooking pot that is enclosed in a clear plastic bag. The panel solar able to achieve temperature up to 66°C to 204°C.

Advantages:

It has better performance than a box solar cooker.

Disadvantages:

1. Panels are unstable in high wind.
2. Do not retain as much heat when sunlight is hidden behind the cloud.

3. Parabolic Reflector:

The parabolic reflector concentrates sunlight on a single point. It can heat the pot quickly to a very high temperature which can often be comparable with temperatures achieved in gas and charcoal grill. This type of solar cooker is mostly used in China and India. Some parabolic solar cookers incorporate cutting edge materials and design which give solar energy efficiency >90%. Parallel rays of sunlight to a point focus lead to focus receiver highly concentrate sunlight and therefore it becomes very hot.

Advantages: It achieves maximum temperature up to 300°C to 350°C.

Disadvantages:

1. Complex design
2. Safety problem.

4. Paraboloidal Reflector:

Paraboloidal Reflector is compound curves (many small segments that are all single curve which forms compound curves) which is more difficult to make.

Advantages: This type of solar cooker achieve high temperature and cook quickly

Disadvantages: It requires frequent adjustment also require supervision for safe operation.

5. Scheffler solar cooker:

A Scheffler solar cooker uses a large paraboloidal reflector which is rotated around an axis that is

parallel with the earth's using a mechanical mechanism. These reflectors of Scheffler solar cooker have a flexible reflecting surface that is capable of changing its curvature to adapt to seasonal variations in the angle of incidence of sunlight. A Scheffler solar cooker is achieve a temperature of 450-650 °C.

Advantage: The Scheffler reflector have the advantage of a fixed focal point.

6. Tube solar oven:

The tube-type solar cooker has a glass tube that concentrates light on a large surface and achieves a maximum of 200°C. It increases the rate of evaporation of wastewater in the food process.

Advantages: In less amount of sunlight it can retain maximum heat, so it can be used in all types of seasons.

Disadvantage: Its capacity is comparatively less.

OBSERVATIONS:

Table no. 1. Various types of solar cookers and their potential usefulness for the preparation of Ayurvedic formulation:

No.	Types of Solar Cooker	Temperature achieve	Ayurvedic Formulation
1	Solar box cooker	150°C	<i>Kwath, Hima, Phanta, Pathya Kalpana</i> are can be prepared on solar box cooker. <i>Bhudhara puta</i> and <i>Kapot Puta</i> can be given.
2	Solar panel cooker	66 °C to 204 °C	<i>Kwath, Hima, Phanta, Pathya Kalpana, Guggul Kalpana, Avleha Kalpana, Panak Kalpana, Ghana Satva, Sneha Kalpana</i> , are can be prepared on solar panel cooker.
3	Parabolic solar cooker	300 °C to 350°C	<i>Kwath, Hima, Phanta, Pathya Kalpana, Guggul Kalpana, Avleha Kalpana, Panak Kalpana, Ghana Satva, Sneha Kalpana</i> are can be prepared on parabolic solar cooker.
4	Tube solar oven	200 °C	<i>Kwath, Hima, Phanta, Pathya Kalpana, Ghana Satva Kalpana</i> are can be prepared on tube solar oven.
5	Paraboloidal Reflector	450-650 °C	<i>Kwath, Hima, Phanta, Pathya Kalpana, Guggul Kalpana, Avleha Kalpana, Panak Kalpana, Ghana Satva, Sneha Kalpana</i> are can be prepared on paraboloidal Reflector.
6	Scheffler solar cooker	450-650 °C	<i>Kwath, Hima, Phanta, Pathya Kalpana, Guggul Kalpana, Avleha Kalpana, Panak Kalpana, Ghana Satva, Sneha Kalpana</i> are can be prepared on Scheffler solar cooker .

Temperature higher than 650 °C also can be achieved by using above mentioned solar cookers by modifications in the design which is can be used for *Marana* process. Some rules are Acharya's explain for preparation of formulation e.g during the preparation of *Kwath* it should be done in an open container (To achieve *Laghavta* in *Kwatha*), it can't prepare in box solar.

DISCUSSION:

In Ayurveda, different types of *Agni* and fuel are explained for the preparation of Ayurvedic formulations. A large amount of solar energy is received by the earth. A solar cooker is a device which uses to convert this solar energy into heat energy and this heat energy can be used for cooking. Different

types of solar cookers are present nowadays, which have advance technology. Some of them are easy to use in a routine lifestyle e.g. Box solar, Tube solar oven.

After studying different types of solar cookers we can say that for the preparation of Ayurvedic formulations parabolic solar cooker, paraboloidal reflector, tube solar oven types can be used. It has better performance than that of the solar box cooker and solar panel cooker. By using this solar cooker we can prepare *kwath*, *Hima*, *Phanta*, *Rasakriya*, *Ghansatva*, *Sneha Paka Kalpana*, *Pathya Kalpana*, *Avaleha Kalpana of Bhaishajya Kalpana*. In *Rasashastra Kalpana kwath* can be prepared which requires various *Shodhana of Rasa Dravya*. For *Marana Kapot Puta* and *Bhudhar Puta* can be done.

CONCLUSION:

This paper proposes an innovative solution to use solar energy in the preparation of Ayurveda medicines. Even though solar energy is available abundantly, there is a limitation to use it because of various factors such as its collection is expensive, and the available energy is not constant throughout the day as well as in a year. Considering these limitations various technologies are developed to adapt to these challenges make them useful for various purposes such as cooking, heating, drying in various process industries, power generation, etc. This energy also can be used for the preparation of Ayurvedic medicines, since most of the Ayurvedic medicine requires heating processes. Specifically, this energy is more convenient for the preparation of liquid medicines such as *Kwath*, *Hima*, *Phanta*, *Sneha Kalpana*, etc.

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