SOLAR DRYING OF SELECTED FOOD COMMODITIES IN ZIMBABWE

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ABSTRACT

A project to develop dryers for small scale drying and relying on natural convection has been launched. Baseline data regarding the solar climate of Zimbabwe has been collected. Radiation, temperature and relative humidity data show that there is a good potential for solar energy applications. A survey of products currently being dried as a means of preservation by the rural people in the various regions of the country revealed a wide range of commodities, such as leaf vegetables, fish, meat and edible caterpillars. The project will evaluate nutrient losses on traditionally dried fruit and vegetables with a view to improve nutrient retention and will also investigate ways of reducing harvest losses.

INTRODUCTION

The climate of Zimbabwe is characterised by one rainy season extending from mid-November to mid-March with the rest of the year dry.

The cultivation of major crops and vegetables tends to be limited to the wet season. The availability of these food commodities tend to follow the seasonality determined by the rain cycle - being over-abundant during the rainy season and scarce or unavailable during the rest of the year. The availability of other food commodities (such as fish) also follows a seasonal pattern, albeit to a lesser degree and for different reasons.

Food preservation is essential to protect against spoilage due to the action of bacteria, fungi, enzymes and chemical action and to meet demand during the rest of the year when the fresh product is not available.

Various technologies exist for the preservation of food stuffs: canning, refrigeration and dehydration, to mention a few. Drying or dehydration is the longest established and the most common method of food preservation in rural Zimbabwe. The range of commodities being preserved is very wide: grain crops (eg maize), leaf vegetables (eg cowpea leaf), fish (eg kapenta), meat and many others. Sundrying in which the commodity to be dried is simply spread in the sun (after varying pretreatments) is the least sophisticated.

PROBLEMS WITH CURRENT DRYING TECHNIQUES

(a) When crops are left in the field to dry losses occur from the action of vermin and from possible rotting caused by re-wetting from rain. A survey (Wellan 1972) showed that losses as high as 10% are common.

(b) Sun drying is slow and inefficient. There is a real danger that the product can spoil before it dries. This is especially problematic with fish, and any unfavourable weather can result in a big catch going bad.

(c) Direct exposure to the sun, normally the practice, results in considerable loss in nutritional value of some commodities like vegetables. An analysis on some traditionally dried vegetables in Harare carried out by the Food Science Department of the University of Zimbabwe showed that there is a marked drop in nutrients (vitamins and proteins) during the drying process. Yet dried vegetables continue to constitute a significant proportion of the diet in rural areas during the dry season.

The need for the artificial drying in order to reduce post-harvest losses and to improve the quality, thus, becomes immediately obvious. The critical shortage of firewood and the high prices of other fuels, leave solar energy as the cheapest energy source. However, harnessing of solar energy for crop drying is a fairly new technology especially in developing countries.

SOLAR ENERGY FOR CROP DRYING

Solar dryers, mostly of the roof sandwich type, have been constructed and tested for the drying of maize, tobacco, lucerne and coffee (Radajewski 1979, Johnston 1979). Since these dryers employ electrically driven blowers to force the hot air through the drying commodity, they were considered unsuitable for rural areas for the following reasons:

(a) electricity is not readily available in most of rural Zimbabwe,

(b) most farmers in the rural areas are poor and cannot afford (individually) the high capital and running costs, that would be involved in a scheme of this nature,

(c) drying in rural areas is generally done on a small scale.

A project directed specifically at the poor rural farmer in which dryers for small scale drying and relying on natural convection are envisaged has been launched. The project has the following objectives:

(a) To evaluate the need for and the technical feasibility of solar drying in order to conserve and extend the food supply to meet the demand when the fresh commodities are not available.

(b) To design, fabricate, test and develop a simple solar air heater that is efficient, inexpensive and easy to construct. The solar collector must be made from locally available material where possible and must have low maintenance. The dryer must rely on natural convection for its operation. Modification and adaptations will be made on some dryer models tried elsewhere.

(c) To develop drying methods and apply these to a range of products selected after some pre-screening tests. The method which must be simple and result in maximum retention of food nutrients during drying and a product with a long storage life.

(d) To disseminate the optimised dryer models and drying technology to the rural areas of Zimbabwe.

PROJECT STAGES

The project has been envisaged in three phases:

Phase I

Resources base identification and evaluation. This includes:

(i) evaluation of available literature.

(ii) compilation and evaluation of climatic data of Zimbabwe: solar radiation, temperature, relative humidity, etc.

(iii) identification and evaluation of existing drying technologies, products being dried and problems met.

(iv) seasonality of crops, etc.

Phase II

Experimental works:

(i) Development and optimisation of dryer models, drying methods and storage methods.

(ii) Quality evaluation of the dried commodities.

(iii) Field testing of optimised dryer model in selected locations.

Phase III

Extension and follow-up.

REVIEW OF PROGRESS ON THE PROJECT

(a) A collaborative network of the Government Ministries of Energy, Agriculture, Community Development and Rural Development and with the University of Zimbabwe has been established. The University of Zimbabwe will play a vital role in the technical aspects of the project by providing laboratory facilities for physical evaluation of dryers and for biochemical analysis of the dried commodity. The other Government Ministries will give field support in the experimental as well as the extension stages of the project.

(b) Data on the climate of Zimbabwe has been collected and evaluated. The results can be summarised as follows:

(i) The mean annual daily total of radiation over Zimbabwe is about $20MJ/m^2$ per day and for 275 days of the year there is bright sunshine for six to eight hours per day. The summer values of radiation are as high as $24MJ/m^2$ per day and winter $16MJ/m^2$ per day.

The Victoria Falls - Binga - Kariba region receives the highest radiation followed by the southern low-veld (Buffalo Range, Chiredzi, Beitbridge). Lowest radiation is received in the Eastern Border Regions of the country.

(ii) Mean annual temperatures vary around 18-19°C at 1,400m above sea level, with highest values (23°C) in the low-veld (Kariba - Victoria Falls and Buffalo Range - Beitbridge). Coolest temperatures (15°C) are experienced in the Eastern Districts.

(iii) The western half of the country experiences the driest weather, recording the lower average relative humidities in the country. The most humid weather is experienced in the Eastern Districts.

Minimum relative humidities are experienced in September/October and maximum values in February. On a diurnal scale, maximum relative humidities are experienced around 14 hrs.

From the above, it can be concluded that Zimbabwe, with the exception of the Eastern Border regions which receive minimum radiation and experiences highest relative humidity, has a very good potential for use of solar energy for crop drying. Temperature fluctuations are not severe and there is no serious threat of frost.

(c) A survey was carried out to identify products currently being dried, their regional, seasonal distribution and also current drying practices. A questionnaire was prepared which solicited for the following information:

(i) name of product

(ii) how the product is prepared for drying, eg cleaning, shredding, etc.

(iii) drying season

(iv) method of drying

(v) how long the product takes to dry on average

(vi) how much of the product is dried at any one time

(vii) how the dried product is stored for later use

(viii) for how long the product can keep before deteriorating

(ix) how the product is prepared for eating

(x) problems, comments, etc.

The result of the survey can be summarised as follows:

(i) The range of products being dried was found to vary little from one region to another except for fish which are from the Lake Kariba shores or the Zambezi River.

(ii) The drying season ranged from late December to May/June (ie the rainy season).

(iii) Drying practices involved mainly:

spreading the product in the sun (or shade) after cleaning, shredding and (sometimes) boiling;

in few cases, steaming followed by direct exposure to the sun.

(iv) The dried product was used mostly for own consumption except for fish, cowpea leaves, okra and edible caterpillars which were for both own consumption and for sale. The tendency to produce for sale is greater around big towns where a ready market is found from the townspeople.

(v) There was little mention of the major grain crops, eg maize, from the list of products being dried for preservation. Perhaps this was because the harvest time for maize, (April/May/June) comes at the end of the rainy season and relatively fewer problems are experienced in having these dry than for the other commodities. However, recently, a request for artificial drying of sorghum so the crop can be harvested earlier and protected from birds - birds being the biggest threat to maturity of sorghum - has been made.

(d) Visits have been made to potential field testing sites at Mrondera, Gwebi, Chiredzi and Nyanga and formal preparations are underway for setting up experimental dryer units.

FUTURE ACTIVITIES

Future programmes in the project can be summarised in the following broad tasks:

(a) setting up of experimental dryers units followed by development and optimisation of the same.

(b) developing and optimising drying methods and quality development of dried products.

(c) disseminating the optimised dryer models and drying methods to the rural areas with assistance from extension agents.

CONCLUDING REMARKS

The climate of Zimbabwe is generally suitable for active utilisation of solar energy for crop drying. Traditionally, drying as a means of preserving food is an established practice. The task of this project is to introduce faster and better drying methods in order to:

(a) reduce harvest losses, eg through early harvest of sorghum

(b) improve on nutrient retention of the dried product especially vegetables

(c) generally extend availability of protein and vitamin foods into the dry season so as to improve the diet of the people.

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