Sun-drying – A low cost Technology for Reducing Postharvest losses

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Abstract
Post-harvest losses in perishable produce are an area that has defied all solutions especially in the developing Countries over time. This is mostly because efforts aimed at solving most of the problems did not address the needs of the under-represented in the society, especially women. Various reasons which can directly or remotely contribute to post-harvest losses have been highlighted. Renewed efforts at reviving the sun-drying culture, which are now more people oriented, are now being embraced all over the developing world. The resource-poor status of most African women demands low-cost technologies that can practically be carried out by the targeted population. These efforts which are aimed at improving already existing practices are expected to have more far reaching effects than previous policies that only ended on the drawing board after the inauguration. This review however highlights pertinent problems which still beset the sun-drying practice in the humid tropic areas of South-eastern Nigeria, like inadequate packaging, and the problem of microorganisms in dried materials due to high moisture levels. Possible and practicable means of solving these problems have also been suggested. [Academia Arena, 2010;2(1):56-59]. (ISSN 1553-992X).

Keywords: Losses, low-cost, post-harvest, sun-drying, technology

Introduction

Postharvest losses of fruits and vegetables are difficult to predict; the major agents producing deterioration mostly being attributed to physiological damage and combinations of several organisms (FAO, 2003). According to Flores (2000), postharvest losses may be grouped broadly into food losses after harvesting and food losses due to social and economic reasons.

Food Losses after Harvesting:

These may include losses from technological origin such as deterioration by biological or microbiological agents, and mechanical damage. Losses due to technological origin include: unfavourable climate, cultural practices, poor storage conditions, and inadequate handling during transportation all of which can lead to accelerated product decay.

Physiological deterioration of fruits and vegetables refers to the aging of products during storage due to natural reactions. Deterioration caused by biochemical or chemical agents refers to reactions of which intermediate and final products are undesirable. These can lead to significant loss of nutritional value such as rancidity and agrochemical contamination, and in most cases the whole fruit or vegetable is lost.

Deterioration by biological or microbiological agents refers to losses caused by insects, bacteria, moulds, yeasts, viruses, rodents, and other animals. During the packing of fruits and vegetables into boxes, crates, baskets, or trucks after harvesting, they are mostly subjected to cross-contamination by spoilage from other fruits and vegetables and from containers. Mechanical damage is caused by inappropriate methods used during harvesting, packaging, and inadequate transportation, which can lead to tissue wounds, abrasion, breakage, squeezing, and escape of fruits or vegetables. Most mechanical damages increase susceptibility to decay and growth of microorganisms.

Food Losses Due to Social and Economic Reasons

Policies: This involves political conditions under which a technological solution is inappropriate or difficult to put into practice; for instance, lack of a clear-cut policy leading to the facilitation and encouraging utilization and administration of human, economic, technical, and scientific resources to prevent deterioration of commodities.

Resources: This addresses the human, economic, and technical resources necessary for

developing programs aimed at prevention and reduction of post-harvest food losses.

Education: This refers to the unknown knowledge of technical and scientific technologies associated with preservation, processing, packaging, transporting, and distribution of food products.

Services: This involves the inefficient commercialization systems, and absent or ineffective government agencies in the production and marketing of commodities, as well as a lack of credit facilities that address the need of the country and the participants.

Transportation: This is related to the grievous problem faced by fruit growers in developing countries, where vehicles used in transporting bulk raw fruits to markets are not equipped with good refrigeration systems. Raw fruits exposed to high temperatures during transportation soften in tissue and bruise easily, causing rapid microbial deterioration.

The Art of Drying: Contemporary Technologies in Parts of Africa

Fresh produce contains up to 95 % water and thus is sufficiently moist to support both enzyme activity and growth of microorganisms (FAO, 1989). The aim in drying is to reduce the water content of the produce to a level insufficient for enzyme activity or the growth of microorganisms. Depending on the commodity, the critical level is about 10 – 15 percent moisture, because removal of too much water may make the product become brittle and shatter easily (FAO, 1989).

In parts of West Africa, notably Senegal, Nigeria and Ivory Coast, the products that are used for drying are generally the surplus of fresh fruit and vegetables not consumed at harvest time. In many parts of Ethiopia that have a prevailing dry atmosphere, sun-drying by open tray method is feasible without the use of solar drying structures. According to Samu-Negus (1985), vegetables in these areas have been reduced to about 10% moisture content by sun-drying, which ensured that they could be stored at moderate temperatures for about 18 months. Also, as a way of reducing the price of the finished product, farmers are encouraged to sell their farm products to agro-industrial processing plants that make use of dehydration equipments, grade the produce into consumer packaging packs, before distribution and marketing. Also in Ghana, sun-dried vegetables, spices and tubers feature prominently in the Ghanaian diet during the lean or off-season (Gyabaah – Yeboah, 1985). The commodities which are sun-dried using the traditional methods of drying on roof tops, on concrete constructions, along roadsides and in courtyards had the disadvantage of being subjected to contamination from dust, flies and even human beings.

According to Fabre and Mihailov (1985), the production, preparation and marketing of horticultural products; especially garden vegetables, are managed by women in West African countries. Therefore, all efforts at improving traditional techniques should be directed towards them. He further suggested the following as possible development prospects for the improvement of sun-drying techniques in Africa:

1. Increase of horticultural production, with part of the increased production being used for sun-drying. The policy of drying only casual surplus of produce should be changed to cultivation of products destined specifically for sun-drying.
2. Losses (up to 50 %) could be reduced through the use of more efficient techniques (adequate pre-treatment of raw products, improved sun-driers, improved storage and packaging).
3. Establishment of small drying enterprises or cooperatives that could produce larger and more homogenous quantities of finished products. This would attract middle-men who could be instrumental in the marketing of larger quantities. However, the quality of the finished product will depend to a large extent, on the quality of the raw material which should be harvested at the proper stage of ripeness and transported carefully and rapidly to the site of drying. In addition, post-harvest handling techniques like careful sorting, washing, cutting or slicing and dipping in dust proof conditions will ensure the good quality of the finished product (Fabre and Mihailov, 1985).

The Status of drying in Nigeria

Although production of all crop types is high in Nigeria, the basic problems of drying, processing, storage and distribution still make supply to fall short of demand nationally (Taiwo, 1985). This results in losses of between 30% - 50% for fruit and vegetable crops. Like it is done all over the globe, farmers in Nigeria, employ the solar energy to save their harvest. According to Taiwo (1985), it is common to see sun-dried peppers; dry powdered okra, fairly sun-dried onion bulbs, and

cowpeas. It is also common to find dry *Corchorus* and water-leaf, partly dehydrated oranges and plantains. Sun-dried yam tuber and semi-processed sun-dried cassava pulp.

The Nigerian Stored Products Research Institute (NSPRI) has also developed techniques for the storage of fruit vegetables and tubers particularly oranges, tomatoes, tomatoes, leafy vegetables, plantain, yam and cassava. These methods which according to Taiwo (1985) are not strictly solar dependent, may in some cases require high-energy like in refrigeration. It is believed that these inventions cannot be practically transferred to the resource-poor farmers in our society, since they may require financial inputs which are not within their reach.

The situation in Nigeria is unlike that of other African countries like Tanzania where a wider range of fruits, vegetables, root and tuber crops are mandatorily sun-dried (amongst other preservation methods) to provide these commodities in the off-season. In Nigeria, the sun-drying culture is not a deliberate effort to save for the 'rainy day', but as a means of mopping up excess harvests which would sooner than later deteriorate. According to Makwaia (1985), the quality of dried bananas, pineapples, mangoes and tomatoes in Tanzania during trials were of reasonable quality. The high protein contents of dried green vegetables were also viewed as a new source of protein in addition to their high minerals and vitamins.

Quality of Dried Tomatoes in the Humid Tropics – South-eastern Nigeria

Dried tomatoes are a common sight in most markets in South-eastern Nigeria. The dried commodity is mostly marketed during the off-season months, generally in the rainy season. These dried products are usually packaged in jute sacks placed inside polyethylene bags. Data collected during a survey of the quality of dried tomatoes marketed in urban markets in Owerri (South-eastern Nigeria), revealed that the dried product usually sourced from farms in Northern Nigeria, had mean moisture contents ranging from 17.51% - 27.20%, depending on the location (Ofor, Unpublished Data).

It was observed that the further the source was from the destination market, the greater the moisture content. Some of the sources were Gashua, Gombe and Zaria (Yobe, Gombe and Kaduna States respectively). There was also a high incidence of microorganisms like *Mucor spp*., *Rhizopus spp*., and *Aspergillus spp*. The packaging of the dried tomatoes was observed to contribute greatly to the high moisture levels within the packages due to condensation, as a result of fluctuating temperatures during transportation. These abnormal moisture levels may now rejuvenate hitherto dormant spores within the commodity. Lots of dust and sand particles were also observed in some of the samples. These contaminants must have come into contact with the commodity during the drying process.

Future Prospects

The revival of solar drying of the more perishable agricultural products (like fruits and vegetables), appears be a promising method of reducing post-harvest losses, improving rural incomes and contributing to self-sufficiency, even of reducing some imports through substitution products (FAO, 1985). Application of pre-drying techniques which ensure colour preservation (like sulphiting), and quicker evaporation of water should be adopted (Fabre and Mihailov, 1985). According to FAO (1985), the operational temperatures for most solar dryers (about 60^0c), preserves the nutritional value and the flavour of processed products. This would mean that Biogas and photovoltaic cells can provide the additional energy required for industrial units. Another area that needs to be urgently addressed is that of an appropriate packaging for the sun-dried commodities. Without appropriate packaging, the aim of alleviating the suffering of the African woman will be defeated. Also, for the sun-drying of perishables to be more effective as to alleviate the lot of the African woman, adequate attention has to be paid to the issue of maintaining the moisture content of the dried produce at a level that will not support the proliferation of microorganisms. Efforts should be geared towards research for possible moisture scrubbers that can maintain a tolerable moisture level in developed packages.

Conclusion

In view of the socio-economic status of the people (mostly women) of Africa who are involved in these small-scale horticultural enterprises, any suggested improvements to the traditional systems of sun-drying should be simple and cheap. This should make use of locally available materials and utilizing local craftsmen's ingenuity and skill. Genuine efforts should be made to take into account the traditional practices prevalent in

different cultures and incorporate them into new technologies wherever possible.

References

FABRE, M. and MIHAILOV, S. 1985. *Report of the first preparatory mission on improvement and development of sun-drying techniques in Nigeria*. In: *Expert Consultation on Planning the Development of Sun-drying Techniques in Africa*. Food and Agricultural Organization of the United Nations, Rome, 1985.

FOOD AND AGRICULTURAL ORGANIZATION (FAO). 1985. *Expert Consultation on Planning the Development of Sun-Drying Techniques in Africa*. Food and Agricultural Organization of the United Nations, Rome, 1985.

FOOD AND AGRICULTURAL ORGANIZATION (FAO). 1989. *Prevention of Post-Harvest Losses Fruits, Vegetables and Root Crops: A Training Manual* (Smith, K. ed.).Series: no 17/2. Food and Agricultural Organization of the United Nations, Rome, 1989.

FOOD AND AGRICULTURAL ORGANIZATION (FAO). 2003. *Handling and Preservation of Fruits and Vegetables by Combined Methods for Rural Areas* (Barbosa-Canovas G. ed.). Bulletin 149. Food and Agricultural Organization of the United Nations, Rome, 2003.

FLORES, G.A.A. (2000). *Manejo Postcosecha de Frutas y Hortalizas en Venezuela. Experiencias y Recommendaciones*. 2nd edit UNELLEZ, San Carlos, Cojedes, Venezuella, 86 – 102.

GYABAAH – YEBOAH, E. 1985. *African Workshop for Improvement and Development of Drying Fruits in Ghana.* In: *Expert Consultation on Planning the Development of Sun-drying Techniques in Africa*. Food and Agricultural Organization of the United Nations, Rome, 1985.

MAKWAIA, B.N. 1985. *Sun-drying of Fruits, Vegetables, Spices, Tubers and other Perishable Products in Tanzania.* In: *Expert Consultation on Planning the Development of Sun-Drying Techniques In Africa*. Food and Agricultural Organization of the United Nations, Rome, 1985.

SAMU – NEGUS, H. M. 1985. *Production of Sun-Dried Products for Local Distribution by Development of an Integrated Technology in Ethiopia*. In: *Expert Consultation on Planning the Development of Sun-drying Techniques in Africa*. Food and Agricultural Organization of the United Nations, Rome, 1985.

TAIWO, T.A. 1985. *Sun-drying of Fruits, Vegetables, Grain, Legumes, Root and Tuber Crops in Nigeria.* In: *Expert Consultation on Planning the Development of Sun-Drying Techniques In Africa*. Food and Agricultural Organization of the United Nations, Rome, 1985.

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