TITLE PAGE

EFFECTS OF TEMPERATURE AND DRYING TIME ON SOME PHYSICAL PARAMETERS OF DRIED VEGETABLES (TOMATO & PEPPER)

BY:

JUBRIL AHMED ALHAJI BIDA

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CERTIFICATION.

This is to certify that this Thesis has been read and approved as meeting the requirements of the Department of Agricultural Engineering, Federal University of Technology, Minna. For the award of Post Graduate Diploma (PGD) in Agricultural Engineering.

Bida 12/9/2000

Jubril Ahmed A. Bida Date.

Student

....

Mr. Peter A. Idah Date.

Supervisor

APPROVAL PAGE

This thesis had been carefully read and approved as meeting the requirements of the Department of Agricultural Engineering, Federal University of Technology ,Minna. For the award of Post-graduate Diploma (PGD) in Agricultural Engineering.

....

Mr. Peter A. Idah Date

Supervisor.

....

Dr. M.G Yisa Date

HOD, Agric Engineering

....

Prof. J.O. Adeniyi Date.

Dean. Post - Graduate School

DEDICATION

This is dedicated to the memory of my mother and father who passed away on 1st March and 31st July, 1979 respectively.

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CHAPTER ONE

INTRODUCTION

Human beings depend directly and indirectly on plants material for sustaining their body frames and structures. Indirectly, man depends on the ruminant livestock's and other herbivore's, domesticated and wild, for converting pasture grasses and green herbs to products that nourish his body.

Directly, man consumes and utilizes a variety of other farms products such as leafy materials, their roots, stems and seeds as sources of nutrients. (Fatuga, 1975).

Vegetables are therefore, important food items in human nutrition for the supply of minerals, vitamins, certain types of hormone precursor in addition to protein and energy.

The yellow and green leave vegetables contain appreciable amounts of Thiamin, carotene and vitamin A. Most vegetables are low in protein and carbonhydrates, whereas peas and beans, used as vegetables are high in protein.(Oyenuga and Fatuga, 1975).

VEGETABLE PROCESSING:

It is noted that processing vegetables started much later with an agro-industrial complex for the manufacture

and canning of tomato concentrates by vegetable and fruits processing Limited Ibadan. They produce new vegetable condiment, such as Tomapep, for the domestic market. Prior to these industrial projects a professional operation had been established by Lisabi mills to dry, grind and can local vegetable like egusi (mellon), pepper and bean.

At the house hold levels, a considerable number of leafy vegetables as well as Okros, chilies and peppers are preserved by sundrying. The vegetables are gathered in season, blanched and spread on mats to dry in the sun by farmers and house wives. In fact large volumes of dried chilies and peppers feature prominently in inter-state trade in Nigeria (Akinrele and Edwards 1975,).

Eke et al (1982) Reported that research activities on the characterization and processing of local vegetables have been on approach ad hoc in Nigeria.

Since these vegetables are essential and since their production are usually seasonal coupled with the difficulties involved in storing them, processing them into the form that will extend their shelf lives is the option left. Drying is one of such preservation methods that is easily carried out. However, the process of drying does not only remove the moisture but some of the produce quality parameters are affected. Assessing some

of these changes especially by varying some of the drying factors is important so as to insure production of desired products. This present work is one of such assessments.

It is important to verify how the drying temperature and time affect some of the physical parameters of tomato and pepper during drying.

1.2 OBJECTIVE:

The Objectives are how different.

1. Investigate the temperatures and drying time influence the changes or otherwise in some physical parameters of tomato fruits and pepper.
2. To quantify such changes.

1.3 JUSTIFICATION OF PROJECT

National survey in some parts of Africa have identified a number of micro-nutrient deficiency problems in post harvest handling of vegetables e.g. Vitamins A and C, riboflavin, folic acid, calcium and iron.

Malnutrition it has been noted is due to poverty and ignorance in developing countries. As such, fruits and vegetables remain the cheapest and commonest source of the micro-nutrients. Nutrient data on green leafy vegetables indicated that they are good sources of 1-carotene, vitamin C, folic acid, riboflavin, calcium

and iron. (Gomez, 1981).

The availability of fruits and vegetables are seasonal. They are particularly scarce during off - season while a lot of ⁂ waste of these highly perishable foods are encountered during the season of over abundance.

There are reasons to believe that vegetable processing in Nigeria should offer a good potential for the diversification of the national economy, as well as providing in good health. It will in some cases be necessary to adapt available foreign technology to process local and improved varieties. This will pose a challenge to our technological research institutions which, given the right leadership and adopting a multi-disciplinary approach, should prove equal to the task.

Agro-industries of the type envisaged for the development of our vegetable resources will not only bring in added value to those products. They will also improve the foreign exchange position of the country savings on important and earning form the exportation of locally processed products. (Eke and Suleiman 1999).

Emphasis on the roll of vegetables on maintaining good health has resulted in overall large scale production of these essential crops. Vegetables are highly perishable when allowed to stay for some days after harvest. Studies

conducted requested that technology adaptable to the local farmers drying is not available.

Fruits and vegetables are heat-sensitive. They present problems like heavy nutrient loss, colour and flavour changes when dried (Kordylas, 1990).

Due to the fact that tomato and pepper are valuable sources of micro-nutrient dehydration technologies to ensure maximum nutrient retention should be employed. Although mineral content of fruits and vegetables are stable to dehydration, the vitamins are highly liable and are destroyed through enzymes, oxidation and photo degradation mechanisms. The conservation of nutrient quality is an important consideration in relation to prevalent micro-nutrient deficiency problems (Gomez, 1981).

It is in view of this that quantifying the changes that occur during the drying of such produce is desirable. For it is noted that in the food supply chain, it is not just increasing the production that is required but how to get what is available to the consumers in the form that it is desired (Oloranda and Aworh, 1983).

CHAPTER TWO

2.1 LITERATURE REVIEW

Human beings depend directly and indirectly on plant material for sustaining their body frames and structures. Indirectly, man depends on the ruminant livestock's and other herbivores domesticated and wild, for converting pasture grasses and green herbs to products that nourish his body. (Oyenuga and Fatuga 1985).

Directly, man consumes and utilizes a variety of other forms of leafy materials, their roots, stems and seeds, as sources of nutrients.

Vegetables are therefore, important food items in human nutrient for the supply of minerals, vitamins, certain types of hormone precursor in addition to protein and energy. Vegetables are important sources of available iron, calcium and ascorbic acid (vitamin C) in human diet. The yellow and green leafy vegetables contain appreciable amounts of thiamin riboflavin and vitamin A. Most vegetables are low in protein and carbonhydrates. Peas and beans, used as vegetables are high in protein, while Irish potatoes, sweet potatoes, yams and sweet cassava have high quantities of carbonhydrates (Oyenuga and Fatuga, 1975).

Vegetable processing it is noted started much later with an Agro-industrial complex for the manufacture and canning of tomato concentrate by vegetable and fruits processing limited (Akinrele and Edwards, 1983). They produced new vegetable condiment such as Tomapep, for the domestic market. Prior to these industrial projects a professional operation had been established by Lisabi Mills to dry, grind and can local vegetables like egusi (Melon), pepper and beans (Akinrele and Edwards, 1983).

At the house hold level, a considerable number of leafy vegetables as well as Okros, chilies and peppers are preserved by sundrying . The vegetables are gathered in season, blanched and spread on mats to dry in the sun by farmers and house wives. In fact, large volumes of dried chilies and peppers feature prominently in inter-state trade in Nigeria. (Suleiman et al 1995)

2.2 CURRENT RESEARCH:

Research activities on the characterization and processing of local vegetables is noted have been very fragmented and ad hoc in Nigeria. This is because they usually originate as incidental problems, spinning off from other related academic or technological investigations (Motoke et al 1995).

Current work is also going on at Oshodi and other

research centres on the nutrient analysis of local leafy vegetables. These have also been extended to cover the effect of processing and home cooking practices on the nutritive values of the products(Suleiman & Motoke 1995).

Oke (1970), reported on the presence of anti-nutritional factors in some local leafy vegetables. The presence and level of toxic substances in the form of, alkaloids and glycol also need to be established from local leafy vegetables and report has it that, they have been successfully fed to protein malnourished children for therapy. (Akinrele and Edwards, 1975).

Promising results arising from these researches it is noted have not yet been taken up by industries, partly because of the low level of vegetable production to support such large industrial processing since the production is still left in the hands of the peasant farmers. Middlemen, it is revealed are able to pose serious threat to organized supply of raw materials to factories because of the fragmentary nature of farmer's small holdings which are widely scattered (Edward 1980).

The growth of vegetable and fruit industries are therefore stunted, expanding only in those products that

can admit imported raw materials. Hence the most active processing activities have been in the bottling of the fruit juices, squashes and carbonated drinks (Edward, 1980).

The other major processing industry in this sector, tomato concentrate canning, has also to a large extent depended on the importation of tomato powder to sustain maintain its production throughout the year. (Edward, 1980).

2.4 FUTURE SCOPE

The interval trade in fruits and vegetable products is currently dominated by the marketing of fresh commodities. As a result of this, the total availability of harvested vegetables for consumption is affected by system of storage, distribution and marketing. Losses in storage due to infestations by insects, bacteria, fungi and rodents are estimated at about 10% on the farm while 12-20% and 20-30% wastage are expected at whole sale and retail level respectively. (Oyenuga and Edward, 1975).

In the area of distribution, problems due to lack of adequate standardized packing and the absence of any special refrigerated transport system also affect the total supply for consumption. Modern technological operations to retrieve these losses and thus up-grade the

economic performance of the local vegetable industries are lacking

2.4 PROSPECTS FOR PROCESSING

The out look for the future of vegetable processing in Nigeria can only be seriously visualized from its potential contribution to national development. The profile of a vegetable processing industry is one that should be well suited to the socio-economic conditions prevailing in the country. In the absence of the industrial set up, the small scale processing especially drying has to be encouraged hence this kind of research to improve on the quality of the products.

It is striking that although special programmes for the production of onions and leafy vegetables are elaborated in the third National Development Plan, no specific consideration was given to their processing (Eke et al 1999) These vegetables are however, noted to have the highest perishability under local post harvest handling. The loss in some instances being as high as 75%. The rational for the low rating of leafy vegetable processing is that consumers always prefer to have them in the fresh state. These arguments are no more tenable in the light of modern freezing, freeze drying and nuclear irradiation technologies by which vegetables can be preserved in a nearly fresh condition. Moreover,

there is a growing export demand for these conditions by Africans residing abroad, while at home, the rapid urbanization rate is already bringing about some inflationary pressures on fresh produce and also processed ones.

2.5 **DIETRY IMPORTANCE**

The role of vegetables as the main sources of vitamins and minerals in local diets very much underscores the need to preserve and make them available in processed form. The normal body requirement for ascorbic acid (Vitamin C) has been escalated by the high viral and bacterial infection rates, experienced under the humid and hot conditions of our environment. Although the vitamin c and thiamine contents of leafy vegetables are known to be very viable under local ambient conditions of storage, it is still possible through proper processing, to reduce the storage losses and ensure stability of some of these nutrients.

Eke (1995) reported that farmers in the Northern part of Nigeria dry vegetables traditionally in open sun, by slicing big size vegetable into four parts and medium or small size into two parts. The sliced of rock facing the inner upwards.

Although open sun drying is energy free drying of

vegetables, but this method is associated with many problems and short comings. The crop is pruned to infestation by micro-organisms and due to the slow rate of drying, considerable percentage of the crop deteriorate rapidly. In addition, large quantity of drying vegetable is consumed or damaged by rodents, birds and other animals pests. Besides, the vegetable is often contaminated with dirt's, sand, plant and animal remains.

The problems associated with the open sun drying of vegetables not withstanding, the demand of this dried vegetables has continued to increase in recent time. The importance of tomatoes cannot be over emphasised, the large quantity of vegetables produced in the Northern part of Nigeria serves as a rich source of vitamin c to the rural farmers. Faryna (1985) maintained that vegetable contains about 50mg of vitamin C in every 100g edible part. Eke et al (1992) designed and fabricated simple inexpensive free convection solar dryer for vegetable using polyethene as cover.

This dryer showed high efficiency in terms of savings in drying time and the quality of the dried vegetables. But the farmers complained that the capacity of the dryer which is about 3kg of fresh sliced vegetable is too small compared to the capacity of about 35kg they dry per batch, in traditional open sun method.

Arinze et al (1990) lamented that large scale dryers commonly used in development or industrial countries are capital intensive, because such dryers use blowers and conventional sources of energy such as electricity, gas, oil and that complexity of these artificial dryers make them not suitable or compatible with the requirements of small to medium scale farmers.

Nigerian farmers are mostly of small and medium scale, who are living in rural areas where there is no electricity, gas or liquid fuel. Moreover, they are low income earners. It therefore means that natural convection solar dryer remains the best option for drying crops in rural areas.

2.6 **TRADITIONAL VEGETABLE DRYING TECHNIQUE.**

In Kaduna State, Hunkuyi and Marabadaja were identified as vegetable producing areas, while large quantities of Okro and pepper are produced in Kufena and Awai respectively (Suleiman & Motoke 1995). These three vegetables are sources of income to the local farmers.

Eke et al (1995) gave the details of how farmers prepare their vegetables and the technical problems they encounter in drying their crops and the importance of wind flow rate in natural open sun drying was identified. In these traditional method, drying space was found to

be of average dimension of 200cm by 350 cm, which takes about 20kg of fresh sliced (tomatoes) vegetables. Based on these findings, large scale inexpensive natural air collection dryer of capacity 45 kg per batch of sliced fresh vegetables (tomatoes) was designed and fabricated.

2.7 DRYING TIME:

Drying time in forced air dryers and low temperature kilns still depend some how on the weather outside and the temperature selected by the operator. Equally important are the dryer design and the quality of sliced vegetables and loading. The drying times are based on actual forced air dryers and low temperature, but should be considered only as rough estimates. No two dryers will give the same performance.

Gastric (1982) and Vicks (1975 b)& (1978a) gave expensive drying data for low temperature Kilns that completely control equilibrium moisture content (EMC), during the early part of drying period Cupett and craft (1971)& (1975), gave results in drying several other species in dryer where the only EMC control is by the dry-bulb temperature.

CHAPTER THREE

MATERIALS AND METHODS

The following are used for the experiment:

a. A fan circulated oven.

b. A knife for slicing vegetables

c. Fresh vegetables (Tomato and Pepper)

d. A digital weighing balance

METHOD

The Tomato and Pepper were sliced in 4 equal parts and equal halves.

~~halves~~. Weight of tomato and pepper were taken dried at different temperatures (60°c, 70°c & 80°c). For each temperature some specified grammes of vegetable were removed after 4hrs, 5hrs and 6hrs, and the following were determined.

1. The moisture content of the product
2. The Texture of the product
3. The Colours of the product

The same physical parameters where measured in the fresh samples before drying.

5 people were used as panelist to evaluate the texture and colour of the product using a coded score

with 5 being the highest valuing and 1 being the lowest. The moisture content was determined using the oven drying method.

Carr (1982) reported that if women were to invest on improved drying technologies, they must regard the activity as one which would fulfil their need. However those were perceivably, and would provide worth while monetary and or non-monetary benefits. The benefits obtainable reflects a basic distinction between two types of drier application, those of produce preservation and produce refinement. Product preservation is usually concerned with pules, cereals, etc, and the main concern is to prevent food losses, with little or no value being added to the product .

The amount of moisture removed in product preservation is generally not high, the crop having partially dried in the field already, and final drying taking place in and around the home. As no increase in value is achieved except through less prevention, the actual losses in these, usually traditional drying systems will determine the maximum cost that can be incurred if improved drying methods are adopted.(Carr, 1992)

On the other hand, products retirement involves dehydration the removal of large amount of water. The

drying of fish, fruits, vegetables and herbs are typical examples of product retirement. This is where value is being added and the cost of drying must be measured together with all other inputs required to produce and possibly market the product. In these cases small scale improved drying techniques are most likely to be accepted and adopted. (Carr, 1982).

CHAPTER FOUR

4.1 RESULT AND DISCUSSION

The results of the physical parameters of the fresh and the dried samples of tomato fruit and pepper dried at different temperatures and drying time are shown in Tables 1,2,3, and 4 and figures 1,to 6.

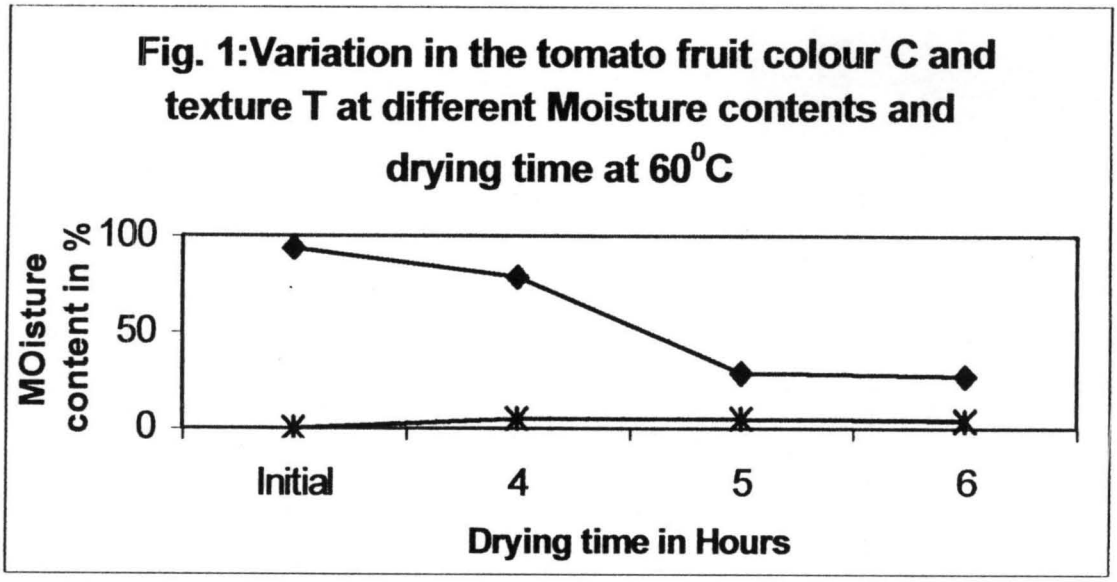
4.2 MOISTURE CONTENT:

The initial moisture content of the samples were determined to be 94% and 90% (wet basis) for tomato fruit and pepper respectively. From Tables 1and 2 the results showed that the moisture decreased progressively at each of the drying Fahrenheit as the time of drying increased.

The decrease in moisture content, is more drastic in the samples dried at 80^0c temperature than those dried at 60^0c and 70^0c temperatures both for tomato fruit and pepper samples. It is however noted that fast rate of moisture removal at times results in case hardening of product(Brenndorfer et al (1995)).

TABLE 1 : Mean Values of Moisture Content (% w.b.) of fresh and dried tomato fruit at 60^0C

Drying Time In Hour	Temperature in Degrees 60^0C		Drying Time in Hour	Temperature In Degrees 60^0C T	C
Initial	94		Initial	5	5
4	78.80		4	5	5
5	28.30		5	5	4.5
6	26..90		6	4.3	4.0



Mean Values of Moisture Content (% w.b.) of fresh and dried tomato fruit at 70^0C

Drying Time In Hour	Temperature in Degrees 70^0C		Drying Time in Hour	Temperature In Degrees 70^0C T	C
Initial	94		Initial	5	5
4	71.6		4	5	4.5
5	16.9		5	4.5	3.7
6	14.80		6	3.7	2.7

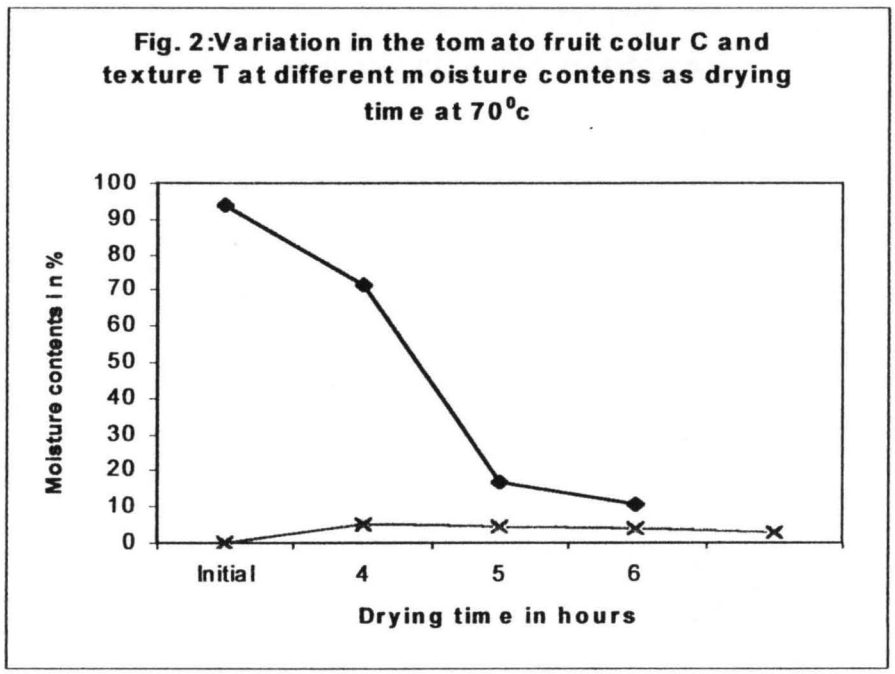
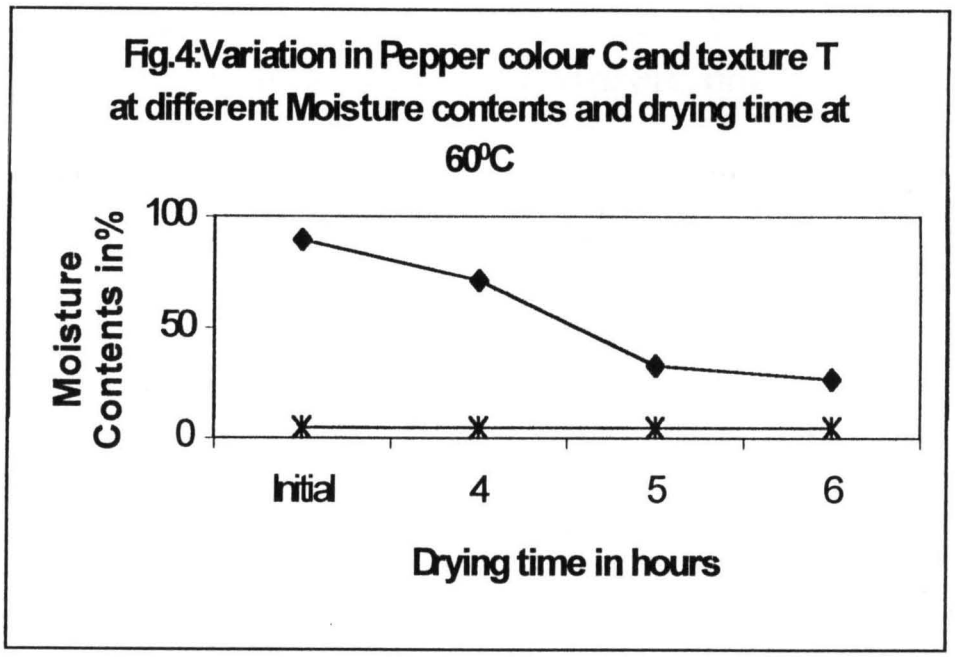


TABLE 2 : Mean Values of Moisture Content (% w.b.) of fresh and dried Pepper fruit at 60^0C

Drying Time In Hour	Temperature in Degrees 80^0C		Drying Time in Hour	Temperature In Degrees 80^0C T	C
Initial	90		Initial	5	5
4	71.5		4	5.0	5.0
5	32.20		5	4.5	5.0
6	26.00		6	4.0	4.7



4.3 TEXTURE AND COLOUR:

The result of the assessment of the texture and colour of the dry and fresh samples of tomato fruits and pepper are shown in Tables 3 and 4 respectively. From the results the initial rating, that is before drying was graded 5. the assessment of the panel used showed that changes in colour was not as pronounced as those of the texture at all the drying temperatures and time.

The results indicated that using the oven drying method, colour variation during drying is not so drastic at the drying temperatures used in this studies. This gradual variation in colour may be due to the fact that the samples were not exposed to the atmosphere after slicing hence the reaction that usually bring about this colour changes were maximised.

The relationship between the changes in colour and texture at different moisture content and drying time keeping the temperature fixed were plotted and the results are as shown in Figures 1 to 6. These results go further to confirm that the changes in texture as the drying times increases is more drastic than those of colour. This results from the panel of assessors could not be unconnected with the fact that as the produce

looses its moisture it shrinks and hence becomes roughened .

Since these physical properties are usually those that are used by consumers in assessing produce, it is important to keep excess alteration in their values in check, and as indicated by these results, the drying temperature and drying time play very important part in this regard.

CHAPTER FIVE

5.1 CONCLUSION AND RECOMMENDATIONS:

The objective of this study was to assess how the drying temperature and the drying time affect come physical parameters of tomato fruit and pepper with a view to generate some basic information that could guide processors and consumers. It can be concluded from the assessment that drying at higher temperatures and over longer period of time could result in excess removal of moisture in addition to causing case hardening. The texture of the produce changes drastically as the drying time and temperature increased.

Since these visual properties are used extensively by consumers in assessing the quality and acceptability of produce, it is recommended that these drying factors be regulated appropriately to give products that will keep for longer period while these visual properties and still matured.

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