EFFECTS OF PRE DRYING TREATMENT ON THE NUTRITIONAL PARAMETERS OF DRIED VEGETABLES (TOMATOES)

BY

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OCTOBER, 2011

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BEING A FINAL YEAR PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIRMENTS FOR THE AWARD OF A BACHELOR OF ENGINEERING (B ENG) DEGREE IN AGRICULTURAL AND BIO-RESOURCES ENGINEERING. FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.

OCTOBER, 2011.

DECLARATION

I hereby declare that this project work is a record of a research work that was undertaken and written by me. It has not been presented before for any degree or diploma or certificate at any university or institution. Information derived from personal communications, published and unpublished work were duly referenced in the text.

__________________ __________________

Ikem Ebube Israel Date.

CERTIFICATION

This is to certify that the project entitled "The Effects of Pre Drying Treatment on the Nutritional Parameters of Dried Vegetables" by Ikem Ebube Israel meets the regulations governing the award of the degree of Bachelor of Engineering (B. ENG) of the Federal University of Technology, Minna, and it is approved for its contribution to scientific knowledge and literary presentation.

ENGR. DR P.A IDAH	7/3/2012
SUPERVISOR	DATE
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DEDICATION

This work is dedicated to God Almighty and to my parents Mr and Mrs Anthony and Francesca Ikem.

ABSTARCT

Tomato (*solanum lycopersium*) was used as sample to study the effects of pre-drying treatments on the nutritional parameters of dried vegetables. The methods used were sulphuring and sulphiting, using a sulphur chamber for the sulphiting tomato. 10g of rock sulphur was used for 1kg of tomato during sulphuring, while 3g of sodium sulphite was used for 1kg of tomato during sulphiting. The nutritional content of the dried sample (vitamin C) was analysed and compared with the untreated sample (control sample). The result showed that the vitamin C content was higher in the pre-treated sample compared to the control sample. The vitamin C sample was increased by 42.9% for sulphured tomato and 62% for sulphited tomato. Also the absorbance rate of sulphur dioxide was also analysed and was found to be 5ppm which is less than the permissible level (2000ppm). Hence, it cannot have any health hazard for human consumption.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Vegetables are those plants which are consumed in relatively small quantities, as a side dişh or a relish with the sample food. Nutritionally, vegetables are good sources of vitamins, protein and fibre.

However, vegetables in their fresh form deteriorate very fast after harvest. To prolong their shelf life, they are preserved by many processes including sun drying, solar drying, and freeze drying e.t.c. Some of these processes, though important for preservation have various effects on the physical and nutritional quality of vegetables. Preservation by drying is effected by lowering the moisture content of the vegetables to a level which micro organisms can no longer grow. The water activity is a measure of the free or available water in a food that is able to react chemically or, in spoilage to support the growth of micro-organism such as bacteria. Therefore, drying reduces the water level. Apart from reducing the water content, drying also affects the quality of the final product.

The quality of dried product must be maintained hence other treatments are usually given to the products. Treatment, such as blanching, sulphuring and sulphiting are processes carried out on vegetables to reduce certain changes in colour and nutritional content during drying. They have been found to improve quality of dried vegetable, (Cluca, 1981).

In this study, therefore an assessment of such pre-drying treatment as they influence some nutritional quality parameters of tomato during drying is been carried out with a view to ascertain the effects.

1.2 Objectives of the Study

The objective of the study is to ascertain the effect of treating tomato using sulphiting and sulphuring on some quality of dried tomato.

1.3 Justification of the study

The consumption of quality vegetables (tomato) has increased worldwide. Vegetables today are increasingly recognised as sources of vitamins, minerals e.t.c. These commodities are highly perishable and must either be consumed rapidly or preserved for later consumption. Since all fresh vegetables cannot be consumed at the time of harvest, it means it must be processed to extend the shelf life. One of such is to convert the fresh product to other forms. One way of achieving this is by drying, however drying do not only reduce moisture content of the product but also affects other nutritional contents. To ensure high quality product, this nutritional parameters must be retained. It is therefore necessary to know how some of the pre-drying treatment affects these nutritional contents of the dried products, hence the need for this study.

CHAPTER TWO

LITERATURE REVIEW

2.1Description of Vegetables (Tomato)

Tomato may refer to both the plant (*solanum lycopersicum*) and the edible, red fruit which it bears. Originating in South America, tomato was spread around the world following the Spanish colonisation of the Americas.

The tomato fruit is consumed in diverse ways, including raw as an ingredient in many dishes, sauces and in drink. Though it is botanically a fruit, it is considered a vegetable for culinary purposes. Tomato belong to the night shade family, the plant typically grows 1-3 metre in height and have a weak stem that often sprawls over the ground and vines over the plant. It is perennial in its habitat, although often grows outdoors in temperate climate, (Sam Cox, 2008).

2.2 Nutritional Contents of Vegetables (Tomato)

The nutritional values of tomato fruit is as shown in Table 2.1.

Table 2.1: Some Nutritional Values of Tomato Fruit (per 100g)

Nutritional Parameters	**Average Values.**
Energy	74k (18k cal)
Carbohydrates	4g
Sugar	2.6g
Dietary Fibre	1g
Fat	0.2g
Protein	1g
Water	95g
Vitamin A	42ug (5%)
Vitamin C	14mg (17%)
Vitamin E	0.54mg (4%)
Potassium	237mg (5%)

FAO (1981)

Tomato contain a lot of vitamins and minerals which are important in human diets, they contain the carotene lycopene, one of the most powerful natural anti oxidants and also fibre which is important for GI (Glycemic Index) function. They contain some important nutrients like vitamin A, vitamin C and vitamin E, which are necessary for the body building, (Cluca, 1981).

2.3 Methods of Vegetable Preservation

Fruits and vegetable are of great of importance in human nutrition as they supply vitamins and minerals to the diet and also provide variety to the food appetizing. Like other agricultural products, vegetables are perishable and must either be consumed rapidly or preserved for later consumption, (*Ames et al.,* 1991).

Since not all vegetables can be consumed at the time of harvest, preservation provides a larger market allowing consumers to buy the product on a year round basis. Drying is one of the major methods of vegetable preservation, and these are carried out immediately after harvest in order to reduce post harvest looses. Drying is a common form of food preservation, because bacteria grow much less readily in dried vegetables than in moist vegetables than in fresh vegetables. Drying of food implies the removal of water from the food stuff and these drying technologies as a process of vegetable preservation, seem to be an adequate method under most conditions in developing countries, Jeakson and Mohammed (1969).

Although there are various forms of drying which includes sun drying, solar drying e.t.c. Drying is so important in food preservation, because it lowers the level which micro organisms can operate. It is a method of food preservation that works by removing water from the food and thus inhibits the growth of micro organisms and hinders quality reduction. Water is usually removed by evaporation. Bacteria, yeast and moulds need the water in the food to grow and drying effectively prevents them from surviving in the food, (Grandidier, 1989).

2.4 Pre-treatment of Vegetables before Drying

Pre-drying treatment processes are necessary for most commodities in order to prepare the commodity in a suitable form for drying, storage and its intended end use. For instance, grading apricot to remove bruised/damaged fruits is conductive to high quality dried product. Chipping cassava to reduce the particle size (and hence, increases the surface area) is essential to achieve sensible drying time. Blanching of tomatoes is necessary to inhibit development of off colours and off odours during drying and storage, (*Morriera et al,* 1998).

Some of the pre-drying treatments usually carried out on vegetables are discussed below.

Cleaning

After harvesting and transporting to the drying site, the first pre-drying treatment operation is usually cleaning, although this is an essential operation for all commodities. Cleaning serves to remove dirt, twigs, stones, insect, insecticide residues and other contaminants. This removal of contaminants reduces spoilage rates, improves the efficiency of peeling equipment and other processing machines and protect machines against damage from foreign materials, (Jeakson and Mohamed 1969).

Grading and Sizing

The grading option is very important in the production of high quality food stuff. Grading may be performed at the time the commodity is received at the drying site, but is sometimes done after cleaning when the physical characteristics of the commodities are better exposed. Factors that may be considered in grading are size, shapes, colour, texture, density, chemical composition, blemishes and insect infestation, maturity and defects which largely determine the quality of the finished products. Therefore grading is important for producing high quality dried product. It should be stressed that during grading the commodity should be handled gently to prevent physical damage. Grading is often a manual process, (Granerus,1991).

Peeling

Many fruits and vegetable requires peeling prior to drying. Since a thick skin presents a physical barrier to moisture, movement, removal aids the drying operations. However, care must be taken not to remove too thick a layer in case valuable nutrients are lost. Manual peeling is the cheapest method for small scale operations. However small scale peelers have been developed, such as the washer peelers, (Olorunde, 1990).

Cutting and Slicing

Unless the commodity is small, it is necessary to reduce its size to achieve uniform blanching and sulphiting, sensible drying time and in a form which is ready for use when reconstituted. Fruits and vegetable may be cut into cubes, slices, rings and shred. Cutting with knife is the cheapest and simplest method, but can lead to non uniformity in products. Several types of machine are manufactured for cutting ranging in size from small hand operated batch type to large automatic, continuous operation, (Onuoha, 1990).

Blanching

Blanching involves the subjection of raw material to boiling points or near boiling temperature for short period. The principal function of blanching is to inactivate enzymes but the operation also partially cooks the tissue and renders the cell membranes more permeable to moisture. More rapid and complete drying is obtained and texture is improved when the blanched, dried product is dehydrated, (Tindall, 1993).

Blanching can either be carried out in water or steam. Water blanching is basically the immersion of the commodity in a container of boiling or near boiling water. Necessary care must be taken to avoid over blanching which leads to loss of texture and difficulties in subsequent drying. Steam blanching involves subjecting the commodity to steam. It is often preferred to water blanching because there is a similar loss of nutrients by leaching and in some vegetable the dried product has an enhanced life. During the blanching process, the time of exposure to the heating medium required for a given commodity depends upon several factors like: size, temperature, depth of load and blanching medium, (Desrossier, 1996).

Salting Techniques

Salts are most frequently used in drying of vegetables and also some edible food stuffs. Common salt is used as an additive primarily to inhibit microbial attack on both vegetables and food stuffs, but also enzymatic browning and discolouration on some fresh meat and fish. It prevents the undesirable effects of hard water on the texture of vegetable during blanching. Since most bacterial cannot survive in salt concentration above 6%, salting will therefore reduce bacterial activity. It is used in the temporary storage and handling of some fruits and vegetables, (Alasalvar, 2010).

2.5 Methods of Vegetable Drying

Sun Drying

Sun drying is simple and has the advantage of being a rationally understood technology with little or no fuel and equipment costs. Basically the products are spread on the ground in an area that has been cleaned off leaves, stones and dirt or it may be spread on mat. The solar energy incident on the thinly spread material provides heat which is required to evaporate water, the mechanism by which the moisture leaves the food material are conduction, convention and radiation and also the rate of drying depends on the available radiation and the ground temperature. The most common additive used in sun drying industries is sulphur dioxide; Sulphur may be used as an antioxidant to prevent degradation of ascorbic acid. Although it has so many limitations, like low and variable quality of products due to over or under drying. A major purpose of sun drying is to reduce spoilage of the vegetables and also to improve its storage life, (Brooker, 1997).

The disadvantage of open air sun drying includes: the intermittent nature of solar energy throughout the day and the different times of the year, possible contamination of the material by dirt and rodents and the infestation of food by insects. Also direct exposure to sunlight reduces the quality of some fruits and vegetables.

Solar Drying

Solar food drying can be used in most areas, but how quickly the food dries is affected by many variables, especially the amount of sun light and relative humidity. Typical drying times from 1-3 days depending on sun air movement, humidity and the type of food to be dried, (Bakker-Arkema, 1992).

Freeze Drying

In this method, the vegetable is first frozen, this will remove the water directly from the ice material, the process is known as sublimation. Freeze drying is a good method of drying vegetable and fruits. Products shrinkage is eliminated or minimised and a near perfect preservation results are expected. Freeze drying also prevents heat damage and produces products with excellent structural retention, (*Lin et al.,* 1998).

2.6 Sulphuring and Sulphiting

Sulphuring Techniques

This is achieved by burning sulphur in a sulphur cabinet. This can be made from locally available materials.

The amount of sulphur used and the time of exposure depend on the commodity, its moisture content and the level permitted in the final product. The food is placed inside the cabinet and sufficient amount of sulphur is placed in a container near the tray. For most vegetable 10-12g of sulphur per kg of food is adequate. The sulphur is then ignited and allowed to burn in the enclosed cabinet for 1-3 hours, (Barbosa-Canovas et al, 2003).

Sulphuring has the advantage over sulphating because it uses rock sulphur, which may be more readily available than sodium sulphite. The fumes of the burning sulphur are unpleasant and can be dangerous to the processor.

Sulphuring Chamber

The sulphuring chamber is an enclosure, in a box form which is used for burning of raw sulphur, and to prevent it from diffusing into the atmosphere. The design and construction of the structure is simple and can be constructed locally by an ordinary carpenter. It is a rectangular structure which is made up of plywood, measuring about 6.5m in length and 4.7m in breadth.

The chamber is incorporated with a perforated net, which supports the loads of the material to be placed on it. The hole is about 1.5mm diameters, to enable the gas to pass through it. It also consists of a tie rod which is used as a frame for the net so that it can be inform of a tray.

Operation

The sulphuring chamber is equipped with 2 racks or net where the vegetables are placed for treatments. The first net is loaded with the vegetables followed by the second. After loading the vegetables, fire is then ignited under the enclosure and the sulphur is then sprinkled into the fire and the burning commences.

Importance of Sulphuring Chamber

It is easy to construct and it is very cheap and simple to use. It also reduces the exposure of raw sulphur into the atmosphere.

Principles of Sulphiting

Sulphiting involves the use of sulphite salts such as sodium sulphite, either by adding them to the blanching water or by spraying a sulphite solution on the commodity by soaking it in a cold solution following blanching.

Blanching in a sulphite solution is particularly useful since it combines two operations into one. The concentration of sulphite salts and the time of dipping, spraying or blanching again depend on the commodity. Solution concentrations for spraying application are typically 0.2 to 0.5, whereas a 0.8% solution is recommended by Jeakson and Mohammed (1969) for soaking time.

Where the chemicals can be obtained, immersion blanching in a sulphite solution might be practical. It is important to control levels of $S0_2$, because a high level gives the food an unpleasant smell and may cause the food to be unacceptable. The strength of a sodium sulphite solution is expressed in parts per million (ppm) otherwise known as mg per kg. By way of the conversion 10,000ppm of SO_2 means there is an overall concentration of 1%.1 litre of water will give 1,000ppm (1.0%) of SO_2. An easy way to prepare a stock solution is to dissolve 12g of sulphite in 1 litre of water to give an SO_2 strength of 8,000ppm (0.8%).By adding More water this different strength can be achieved, Jeakson and Mohammed (1969).

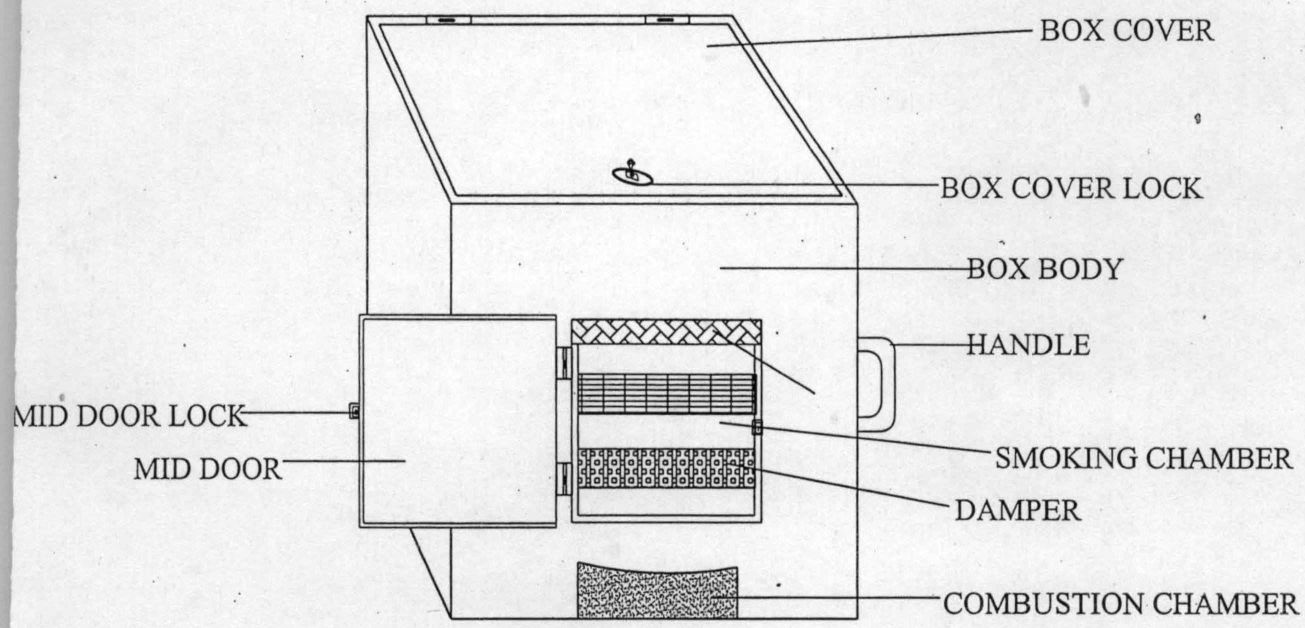

Fig 2.1 SULPHUR CHAMBER

2.7 Effects of Sulphuring and Sulphiting on the Nutritional Content of Vegetables (Tomato)

Vegetables are recognized for their vitamins and colour, therefore sulphuring and sulphiting help to improve the colour, rehydration ratio, minimizes the loss of ascorbic and lycopene in food during drying and also improve appearance, flavour, texture or storage properties.

CHAPTER THREE

METHODOLOGY

3.1 Sample Preparation:

3.2 Materials

The following materials were used in carrying out the experiments;.

Plywood, screen material, wooden blocks, water, knife, reagents, rock sulphur, sodium sulphite, and tomatoes.

3.3 Methods

Two different methods of pre-drying treatments were used on tomatoes. The pre-drying treatments were sulphuring and sulphiting. A sulphuring chamber was designed and constructed while suphiting was done using a steamer.

The pre-treated sample and a control sample were dried using an oven dryer in the animal production laboratory.

Sulphuring Chamber Design and Construction

The main features of the sulphur chamber are an enclosure with adjustable vents and a tray net stacked one above the other. Each tray (net) was filled with the tomato and it was arranged one above the other, before covering with plywood box (an enclosure).The shallow container containing burning sulphur was placed underneath the tray to produce the sulphur dioxide which permeated into the food tissue.

Construction Calculation

1 kg of vegetable was needed, 1 tomato seed weighed 59g

:- 17 tomato average make 1000g = 1kg.

5 slices of tomatoes of 6mm in thickness was produced from 1 seed of tomato.

:- 17 tomato will give averagely

17 x 5 = 85 slices.

The average diameter of the slice is approximately 30mm

30×10^{-3}m

Area = $4\pi r^2$

r= d/2

r= 15×10^{-3}m

Area = $4\pi (15 \times 10^{-3})^2$

The total area that 85 slices will occupy will now be

$2.828 \times 10^{-3} m^2 \times 85 = 0.24m^2$

Total area = $0.24 + (0.1 \times 0.24) m^2$

= $0.27m^2$

If the ratio of length of breath is 1:1:4

Area = B x 1.46

B = 0.44m.

L = 1.4 x B

L = 1.4 x 0.44m

L = 0.615m

3.3.1 Sample Preparation

Untreated Tomatoes

One kilogram of clean fresh tomato was measured using weighing balance. The tomato was then sliced into about 6mm thickness and arranged inside the oven at 80^0C for four hours after which the oven was switched off and dried tomatoes were collected.

Dried Sulphured Treated Tomatoes

One kilogram of clean fresh tomatoes was weighed using a weighing balance. This was now sliced into 6mm thickness. The sliced tomatoes were arranged inside the tray (net) and 10g of sulphur (rock sulphur) was sprinkled into the already made fire contained in a shallow container which was placed underneath the tray. The whole system was covered up with enclosure made of plywood. The position of the container was changed at every 30 minutes, and then the sulphur burnt for one and half hour. The sample was now arranged inside an oven for about 80^0C for four hours, after which a dry sample was collected.

Dried Sulphited Treated Tomatoes

The fresh tomatoes were washed clean and one kilogram was taken using weighing balance, this was now sliced into four parts and arranged inside the perforated plastic bowl.

Three grams of sodium sulphite was dissolved in one litre of water and the solution was placed on fire and allowed to boil. At boiling point, the tomato was exposed to the steam by placing it at the upper section of the pot containing the boiled water and covered with lid. This was done for about 10 minutes, after which the sulphited tomatoes were removed. The sample was arranged in an oven at about 80^{0}C for four hours, after which the dried tomato was collected.

3.4 Determination of Vitamin C

Method (TDRI)

Reagents

Glacial acetic acid

Chloro form

2, 6, dichlorophenol indophenols (0.001m)

Distilled water

Ascorbic acid

Procedure

Five millilitres of each of the sample was prepared and two millilitre of glacial acetic acid and one millilitre of chloro form (since the samples are coloured) was added to each of the prepared sample. And this was then titrated into a solution of 2, 6 dichlorophenol indophenols contained in the burette and this was continued until a permanent faint pink colour was obtained. The titre was then noted and recorded.

The procedure was repeated using five millilitre of distilled water for the blank (B_1) and five millilitre of standard (STD) ascorbic solution (st). As shown in Table 3.1the vitamin C content in the sample was calculated using this formula:

$$\frac{T - B_1 \times n}{STD - B_1} \ (mg/100ml)$$

Where

T=Value of Sample

B=Blank

STD=Standard solution of ascorbic acid

n=Dilution factor

Table 3.1: Analysis of vitamin C on both samples:

Samples	Initial Reading	Final Reading	Average Titre Value
Untreated Tomato	6.00	6.30	
	6.30	6.50	0.23
	6.50	6.70	
Sulphited Tomato	6.70	7.10	
	7.10	7.40	0.26
	7.40	7.70	
Sulphured Tomato	7.70	7.90	
	7.90	8.20	0.26
	8.20	8.50	
Blank	8.50	8.70	
	8.70	8.90	0.20
	8.90	9.10	
Standard	9.10	9.50	
	9.50	9.90	0.40
	9.90	10.3	

Table 3.1 above showed the analysis carried out on tomato, to determine the vitamin C content. The average titre value was used to calculate each of the vitamin C contents in each of the product sample.

3.5 Determination of Absorbance Rate of Sulphur dioxide

Method (TDRI)

Reagents

Distilled water

5ml hydrochloric acid

1% starch solution

0.05N iodine

3% hydrogen peroxide

0.05n potassium iodide

Eight grams of the ground dehydrated material was suspended in two 600ml beaker containing 400ml of water, and then 5ml of sodium hydroxide was added. It was then stirred gently so as not to beat air into the solution and was then allowed to stand for 20minutes.7ml of 5n hydrochloric acid was added to one of the sample and stirred to avoid local concentration. Then10ml of 1% starch was added and titrated (V_1ml) the acidified sample was titrated immediately with 0.05 iodine to definite blue colour (V_1ml).The acidified sample was titrated at once before recombination occur. The second sample was hydrogen peroxide to oxidize the sulphite to sulphate. The sample was then titrated with iodine to blue colour (V_2ml)

The blank was prepared with water, alkali acid starch and hydrogen peroxide as above but with no sample.10ml of 0.05n potassium iodide solution was added to the blank. If no blue colour is developed within 30 seconds this shows that the solution is stable until well after titration of the non sulphite iodine reducing materials has been completed.

Calculation of the result

1ml of 1n iodine = 0.032g SO_2

: - PPm SO_2 = ml of iodine to titrate sample

$$PPM\ SO_2 = V_1 = \frac{V_2 \times 0.05 \times 0.032 \times 10^6}{m}$$

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Results

Table 4.1 Summary of the Result of the Nutritional Quality Parameters of Tomato Sample

Values of Vitamin C

Product Sample	**Before Drying**	**Average Value Before Drying**	**After Drying**	**Average Value After Drying.**
Untreated Tomato	19mg/100ml 19mg/100ml 19mg/100ml	19mg/100ml	16mg/100ml 17mg/100ml 17mg/100ml	16.6mg/100ml
Sulphite Tomato			50mg/100ml 50mg/100ml 50mg/100ml	50mg/100ml
Sulphur Tomato			33mg/100ml 33mg/100ml 34mg/100ml	33.3mg/100ml

Table 4.2: Average Vitamin C Content in the Pre drying treated and Untreated Sample.

	Control	Sulphuring	Difference	%	Sulphiting	Difference	%
Tomato	19mg/100ml	33.3mg/100ml	14.3	42.9	50mg/100ml	31	62

Table 4.3: Sulphur dioxide Absorbance Rate.

	Sulphuring	Sulphiting
Tomato	5.01ppm	5.01ppm

Table 4.4: Summary of the Observed results.

Dried Sample	Amount of Vitamin C	Rate of Drying	Appearance
Sulphuring Tomatoes	33.3mg/100ml	Faster	Good Appearance.
Sulphiting Tomatoes	50mg/100ml	Faster	Good Appearance.
Untreated Tomatoes	19mg/100ml	A Bit Slower	Dull Brown.

4.2 Discussion of Results:

4.2.1 Nutritive Quality Changes:

The effects of pre drying treatment on the nutritional qualities of tomato using sulphuring and sulphiting, shows that there was an increase in the vitamin C content of the tomato. The table: 4.1 show that the amount of vitamin C in the treated and untreated tomato before drying and after drying differs. In the treated tomatoes sample it was 50mg/100ml for the sulphited tomato and 33.3mg/100ml for the sulphured tomato, also the untreated tomato before drying was 19mg/100ml while the untreated tomato after drying was 16.6mg/100ml. Table 4.2 also shows that there was a 42.9% increase in the vitamin C content of the sulphured tomato, while for the sulphited tomato there was an 62% increase also in the vitamin C content.

Untreated Tomatoes before Drying:

Before the untreated tomato sample was dried, a nutritional test was carried out on it to ascertain the amount of vitamin C contained in it. It was calculated and found to be 19mg/100ml.

Untreated Tomato after Drying:

The effects of pre-drying treatment on the nutritional parameters of dried tomatoes after drying was being carried out so as to investigate the amount of vitamin C contained in it. It was calculated and found to be 16.6mg/100ml, also during titration the untreated dried tomato changed rapidly to a pink colour which indicates a lower level of vitamin C content. The vitamin C content in the dried untreated tomato was found to be lower, as compared to the untreated tomato before drying which was 19mg/100ml. This shows that some vital vitamins were lost as a result of the heat applied to the dried untreated tomato during drying, also during drying it was observed that the water content in it dried relatively slow.

Sulphured Tomatoes:

The effect of pre-drying treatment on the nutritional parameters of dried tomato shows that, in the sulphured tomato, during drying it was observed that the water content in the sulphured tomato dried faster with relative ease, as compared to the untreated tomato. Also during the analysis of vitamin C carried out on it, the sulphured tomato was found to change slowly to a pink colour during titration, as compared to the standard solution (ascorbic acid). Thus this indicated an increase in the vitamin C content of the tomato, and the vitamin C content was calculated and it was found to 33.3mg/100ml. This shows there was an increase in the vitamin C content by 42.9% as compared to the untreated tomato before drying.

Sulphited Tomato:

The effect of pre-drying treatment on the nutritional parameters of dried tomato shows that, in the sulphited tomato during drying, it was observed that the water content in the sulphited tomato dried very fast as compared to the untreated tomato. Also during the analysis of vitamin C carried out on it, the sulphited tomato was found to change slowly to a pink colour during titration as compared to the standard solution (ascorbic acid). Thus this indicated an increase in the vitamin C content of the tomato, and the vitamin C content was calculated and was found to be 50mg/100ml. This shows there was an increase in the vitamin C content by also 62%, as compared to untreated tomato before drying.

4.2.2 Physical Quality Changes:

Colour/Appearance

After the pre drying treatment given to the tomato, it was observed that the pre-treated tomatoes had good appearance (bright and red) as compared to the untreated tomatoes which seems to have a very dull brown appearance, and also it dried faster than the untreated tomato. Also table 4.3 shows that the absorbance rate of sulphur dioxide for both the two methods of pre treatment for tomatoes was approximately 5ppm. This is far below the maximum permitted levels of sulphur dioxide in foods, (Anon 1979). This shows that sulphuring and sulphiting can be successfully used as pre treatment for tomatoes.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion:

Tomatoes were treated using sulphuring and sulphiting methods, the qualities of the vitamin C on the treated and untreated sample were analysed as to know the effects of the pre-drying treatment on the nutritional quality parameters of dried tomatoes. During the analysis for vitamin C, the qualities of the vitamin were higher than that of the untreated one. The quantity of So_2 in the treated tomato was also analysed and it was found to be very small, which made the treated tomatoes safe for consumption.

In conclusion, pre-drying treatment has great effects on the nutritive quality parameters of tomatoes. Sulphuring and sulphiting can be successfully used as treatment for tomatoes before drying. There is no health hazard associated with this method of pre-drying treatment as long as the recommended quality of sodium salts and rock sulphur is used. The pre-drying treatment also enhances the vitamin C contents and it retention on the dried products, it also reduces the drying time and improved the appearance of the dried products.

5.2 Recommendation:

From the results obtained it shows that if the required method and quantity of salts and sulphur is used, it acts as a preservative for tomatoes and also increases the vitamin C content. I recommend that further research project should be carried out on various methods that can be used for treatment of tomatoes, so that these methods could be used to improve the sustainability of quality parameters of dried tomatoes.

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Pictures taken during practical carry out

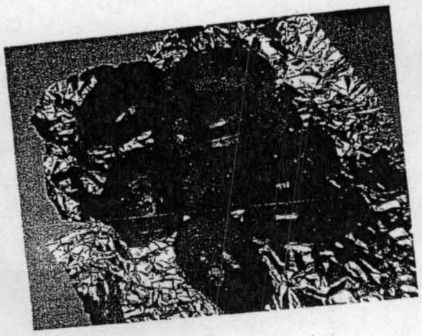

Plate 1. Fresh Washed Tomatoes.

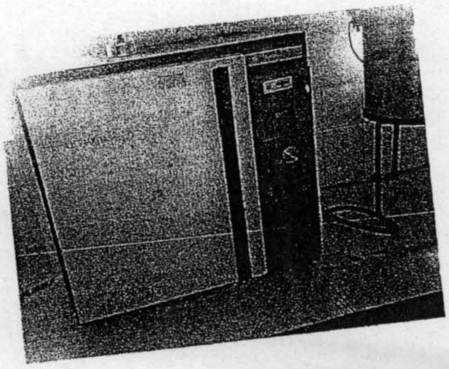

Plate 2.Oven

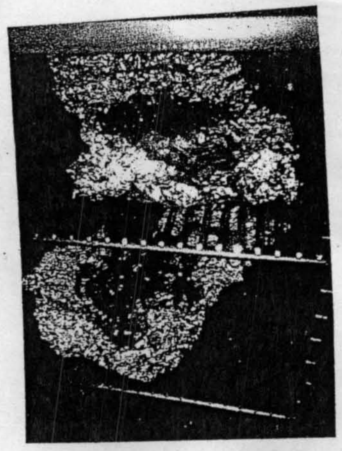

Plate 3. Dried Sample in the Oven.

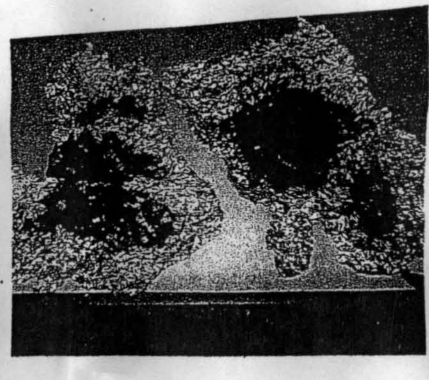

Plate 4.Treated Tomatoes.

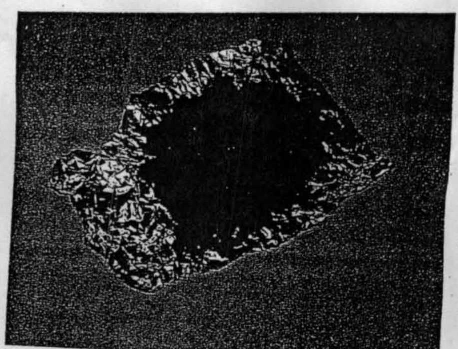

Plate 5. Grounded Untreated Sample.

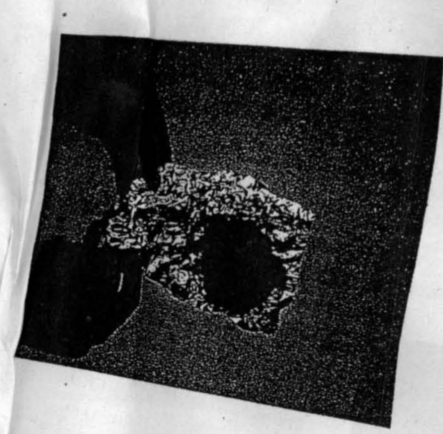

Plate 6.Sulphite Tomatoes.

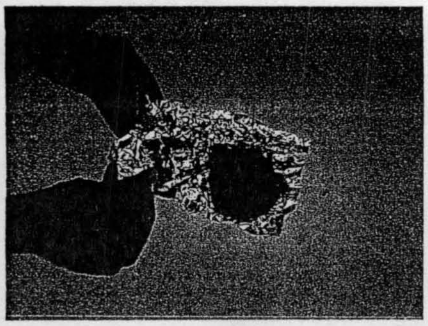

Plate 7.Sulphured Tomatoes