

# The Drying Effect of Varying Light Frequencies on the Proximate and Microbial Composition of Tomato

Kolawole, O. M. (Corresponding author)

Department of Microbiology, University of Ilorin

P.M.B 1515 Ilorin, Kwara State, Nigeria

Tel: 234-806-008-8495 E-mail: tomak74@yahoo.com

Kayode R. M. O.

Division of Biotechnology, Department of Food Science and Home Economics

University of Ilorin, P.M.B 1515, Ilorin, Nigeria

Tel: 234-080-3585-0545 E-mail: kayodermosnr@yahoo.com

Aina, J.

Department of Microbiology, University of Ilorin

P.M.B 1515 Ilorin, Kwara State, Nigeria

Tel: 234-803-629-3994 E-mail: runawayfromsin@yahoo.com

## Abstract

Tomato samples were dried at different frequency of light using clothes of different colours with wooden drying fabrication. The proximate composition and microbial count of the Tomato fruits were determined. Results showed that temperature and relative humidity of the environment affected the rate of drying of tomato as well as the growth of spoilage organisms in the fruits. Highest temperature values of tomato was observed in the control and light red colour frequency which also had a slightly lower average bacterial count ( $53 \times 10^3$  cfu/g and  $62 \times 10^3$  cfu/g) respectively. The light purple colour had highest average bacterial count of  $96 \times 10^3$  cfu/g which was significantly higher ( $P < 0.05$ ) compared with the control and other colour frequency. Tomato dried with light green colour frequency had the highest amount of protein and carbohydrate (13.78% and 51.37%, respectively). Dark blue colour had the highest amount of fat (0.97%), light blue colour had the highest fibre (25.30%), while the highest percentage of ash was observed in black colour (54.30%). All data from the colour frequencies were significantly different (higher or lower) from the control at ( $P < 0.05$ ). Microorganisms isolated from tomato fruit during drying were: *Erwinia carotovora*, *Proteus* sp, *Bacillus* sp, *Micrococcus luteus*, *Aspergillus* sp, *Aspergillus niger*, *Rhizopus stolonifer*, and *Penicillium chrysogenum*.

**Keywords:** Tomato fruits, Colour frequency, Wooding drying, Bacterial counts, Proximate composition

## 1. Introduction

The rate at which food spoils especially in developing countries is alarming. Various reasons have been adduced for this. These include: poor method of preservation, transportation problems, and low price of farm products during harvest season among others. Hence the need to preserve food cannot be overemphasized. Traditionally, drying has been used as a method of preserving foodstuffs in Nigeria and other developing countries. However, solar food drying is one of the oldest agricultural techniques related to food preservation. In many countries of the world the use of solar thermal systems in agricultural area to conserve vegetables, fruits, coffee, and other crops has shown to be practical and economical (David and Whitfield, 2000).

Tomato; (*Lycopersicon esculentum*) belongs to the family *solanaceae*. Tomatoes are one of the most popular, versatile, and widely grown vegetables throughout the world and in nearly every home garden. They were first grown in Europe for ornamental purposes. Cultivation for a food crop soon was established along with its dispersion throughout Europe and other areas. The crop began to be cultivated in North America in the early 1700s (Hartman *et al.*, 1988). The general composition of fresh tomatoes has been reported to be water (93.0%),

protein (1.1%), and fat (0.3%). The micronutrient per 100g dry matter were calcium (11mg), iron (0.6mg), vitamin A (700IU), Thiamine (0.06mg), Riboflavin (0.04mg), Niacin (0.5mg), Ascorbic acid (23mg) (Ihekoronye and Ngoddy, 1985). However, the composition of dried tomato was reported by Atteh (2002) to be crude protein (21%) and crude fat (10%). Careful application of supplemental irrigation is helpful in avoiding potential disease and quality problems. Unfortunately, tomato production is frequently plagued by serious bacteria, fungi and viral diseases (Goldoni *et al.*, 1992; Salawu, 2005).

The sun emits the most of its radiation in the visible range, which our eyes perceive as the colours of the rainbow. Our eyes are sensitive only to this small portion of the electromagnetic spectrum. The visible light covers the range of wavelength from 400-700nm (Frequency range of  $430-750 \times 10^{12}$  Hz). Preservation of tomato by drying is important to prevent microbial spoilage of the fruits. This study therefore, intends to determine the drying effect of the varying colour light frequencies on the proximate and microbial composition of tomato fruit.

## 2. Materials and Methods

### 2.1 Collection and Preparation of Sample for Analysis

Fresh tomato fruits devoid of any injury were obtained from University of Ilorin permanent site mini-market. The tomatoes were collected in clean sterile polythene bags and were brought to the laboratory for analysis. The samples were sun dried for one week in sixteen (16) small plastic containers coated black in the inner surface. The plastic containers were arranged in two wooden fabrications exposed to direct sunlight. The fabrication is a long wooden box with 8 holes for the plastic containers. Small holes were also made on the lower part of the container, allowing for the free flow of air and preventing accumulation of water. Two hundred grammes of the sample was placed in a container in one of the holes in the fabricated wooden box, properly covered with a white textile material, corked and left in the sun to dry. The procedure was repeated for the other colour i.e. black, red, orange, blue, green, purple and brown in duplicates of the light and deep colours of the same textile material while the control was without any covering of the cloth material (Kolawole *et al.*, 2009).

### 2.2 Determination of Temperature

The temperature of the tomato fruit was determined using a clean mercury bulb thermometer which was passed through a hole located by the side of the container into the center of the sample. The thermometer was allowed to stay for about 3 minutes after which the temperature of tomato in degree centigrade was read. This was carried out 6 times daily at an interval of 3 hours.

### 2.3 Determination of pH

Laboratory Radiometer – Acid-Base analyzer with glass electrodes was used to measure the pH. This was done by inserting the electrode into 10ml suspension containing 1g of the sample homogenized in 9ml of sterile distilled water. The apparatus was standardized with (buffer) solution of pH 7.0, 4.2, 9.0 before used.

### 2.4 Determination of Proximate Composition

The moisture content, crude protein, crude fat, crude fibre, carbohydrate and crude ash of tomato fruit were determined using the methods of AOAC, (1984) and Bakare, (1995).

### 2.5 Determination of Vitamin C

Five grammes of dried tomato was ground and homogenized in 45ml of distilled water. The suspension was then filtered. Five milliliters of the filtrate was pipetted into a 250ml conical flask & 0.1ml of glacial acetic acid was added. Dichlorophenol indophenol was titrated against the filtrate sample in the flask until the solution become faint pink. The Vitamin C content was then calculated using the method of AOAC, (1984).

### 2.6 Preparation of Media, Isolation Techniques and Characterization of Isolates

All the media used were prepared according to the manufacturer's instructions.

Isolation and characterization of bacterial and fungal isolates were carried out according to the method described by Fawole and Oso, (2004). The Bergey's manual of Determinative Bacteriology (Bucchanans and Gibbons, 1974) was used for identification of bacterial isolates. Fungal identification was carried out according to the procedures described by Samson and Van Reen-Hoekstra (1982).

### 2.7 Statistical Analysis

The results were presented as mean  $\pm$  SEM. Data collected were analyzed by ANOVA. While significant differences among the mean were determined using Duncan's multiple range test

### 3. Results

The result of temperature measurement of tomato fruit in each of the colour frequency used for drying showed that there was no significant difference at  $p < 0.05$  among the means of sample of the same colour over the 7 days of drying. However there was significant decreased in temperature between the varying colour frequencies compared with the control (Table 1). The pH of the tomato samples generally ranged from 6.5 to 8.5. The pH increased generally across the colour frequency during drying, except for black colour where there was a relative decrease in pH. There was relative increase in pH in the dark red, light orange, dark orange, dark yellow, dark purple and dark brown colour frequencies compare to the control. However, increase in pH in the varying colour frequencies was not significantly different from the control (Figure 1). The weight of tomato after drying in each of the colour frequency decreased significantly after drying from 500g of each of the fresh sample to as low as 11g in the tomato dried with light brown colour frequency. The increased in weight in the dark orange and dark brown colours were significantly different from the control compared to other colour that showed no statistical significance ( $P < 0.05$ ) (Figure 2).

The result of the proximate analysis showed that, there was significant difference ( $p < 0.05$ ) in the moisture content of tomato dried with the different colour frequency compare to the control. The moisture content of the tomato ranged from 95.88% for tomato dried in the white colour frequency to 98.35% for those dried in the light purple colour (Table 2). It was revealed that light green colour had the highest amount of protein and carbohydrate (13.78%, 51.37% respectively), dark blue colour had the highest amount of fat (0.97%), light blue colour had the highest fibre (25.30%) while the highest percentage ash was recorded in black colour (54.30%). However with the exception of percentage moisture content and crude fat, all the other proximate parameters were significantly different ( $P < 0.05$ ). The result also reveal that a total of four bacteria and four fungi were isolated from the tomato samples during the period of drying. The bacteria isolated were *Erwinia carotovora*, *Proteus species*, *Micrococcus luteus*, and *Bacillus species*. While the Fungi isolates includes *Aspergillus species*, *Aspergillus niger*, *Rhizopus stolonifer*, and *Penicillium chrysogenum*. Figure 3, showed the total bacterial count from samples of each of the colour frequency used for drying. Tomato in the light purple has the highest total bacterial count ( $96 \times 10^3$  cfu/g). The average fungi count of Tomato dried in the light green colour and light purple box were generally high ( $83 \times 10^3$  cfu/g and  $82 \times 10^3$  cfu/g) respectively. Those in the dark red colour and dark brown colour have the lowest fungi count,  $5 \times 10^3$  cfu/g and  $8 \times 10^3$  cfu/g respectively (Figure 4). Table 3 shows the distribution of all the isolates in tomato dried with the various colour frequency of light.

### 4. Discussion and Conclusion

In this study, the result of temperature measurement of tomato in each of the colour frequency used for drying showed that there was no significant difference at  $p < 0.05$  among the means of the same colour over the 7 days of drying. However there was significant difference between the varying colour frequencies compared with the control (Table 1). This finding is in consonance with the reports of Andrew and Harrison, 2006; Kolawole *et al.*, 2009. The pH of the tomato sample was generally in the neutral and alkaline region. The pH increased generally across the colour frequency during drying, except for dark brown colour where there was a significant decrease in pH. There was a significant increase in pH in the dark red, light orange, dark orange, dark yellow, dark purple and dark brown colour frequency than the control. Increase in pH in other colours was not significantly different from the control. This may be responsible for the high bacterial count recorded during the drying period. This is in agreement with Prescott *et al.* (2005); Jawetz *et al.*, (1991) who reported that in neutral or alkaline pH foods, bacteria are more dominant in spoilage and putrefaction. The weight of tomato after drying in each of the colour frequency decreased significantly after drying from 500g of each of the fresh sample to as low as 13g in the tomato dried with dark frequency. The decreases in weight in the dark orange and dark brown colour were significantly different from the control while other colours were not so significantly different. The low weight of tomato dried with colour frequency of Green, Blue, Purple and Red colour may be as a result of increasing rate of drying by this frequency range or due to lost of sample in transit during carriage for weighing (Khanthron, 1992).

In the proximate analysis of tomato, the percentage moisture removed by drying with the various frequency of light was not so significantly different. However, tomato dried in the light purple, dried faster such that more moisture (98.35%) was removed than those dried in dark red (96.95%). This may be due to increased rate of drying. For the protein analysis of tomato after drying, there was no significant difference between those dried in the light purple, dark purple, light yellow, black and dark blue frequency. But there was significant difference between those in the control, light blue, dark purple and light orange frequency. Tomato in the control had the lowest amount of crude protein (4.79%) possibly because of the low level of microbial contaminant (Average bacterial count of  $51 \times 10^3$  cfu/g). Those dried in the light brown colour had the highest percentage of crude

protein (13.75%). This may be due to more microbial contaminants (Cotran *et al.*, 1999; Diane, 2004). For ash and fibre analysis, there was significant difference between tomatoes dried in the dark red and dark purple frequency. However, light orange, dark orange, dark green and white frequencies showed no significant difference. Percentage ash, crude fat and crude fibre generally increased after drying with the tomato in the light green, light blue, and dark blue colour having more values. Atteh (2002) reported a similar increase in the level of crude protein, fat, fibre and ash of dried tomato. David and Whitfield (2000), also reported that dried foods are high in fibre and carbohydrates and low in fat, making them healthy food choices. The control had vitamin C content of 20.50mg/kg which was not significantly different from that obtained in the dark green, and dark red colour. Lowest amount of vitamin C was observed in dark orange colour. Various other colours showed significant difference in the amount of vitamin C content. There was a noticeable decrease in the amount of vitamin C of tomato after drying compared with that of the fresh sample. This may be due to the fact that vitamin C content of food is destroyed by exposure to heat (David and Whitfield 2000, Ihekoronye and Ngoddy, 1985). Tomato in the light purple frequency had the highest average bacterial count ( $96 \times 10^3$  cfu/g) while those in the white colour has the lowest ( $49 \times 10^3$  cfu/g). The relative high amount of average bacterial count in the Green, Blue and Purple frequency may be due to contamination or presence of microorganisms that can withstand these frequency ranges (Kurt and William, 1989). From the result of the effect of temperature on the growth of isolates, it was found that majority of the fungi can grow well at temperature above 30°C. *Aspergillus* sp. Survive high temperature unlike *Rhizopus stolonifer* which grow well at room temperature. *Rhizopus stolonifer* is very common and is involved in the spoilage of many foods.

In conclusion, it was observed that tomato dried with light green colour frequency had the highest amount of protein and carbohydrate (13.78% and 51.37% respectively). Dark blue colour had the highest amount of fat (0.97%), light blue colour had the highest fibre (25.30%) while the highest percentage of ash was observed in black colour (54.30%). All these colours were significantly different at  $p < 0.05$  from the control. Though the blue and the green colours have a slight increase in microbial count, proximate composition of tomato dried under this frequency range were higher, if contamination is carefully avoided, blue and green colour frequency may be better if used for drying.

## References

- AOAC. (1984). *Vitamins & other nutrients*, Official methods of analysis of the Association of official analytical chemist 14<sup>th</sup> edition, (Williams S.ed) Virginia, 834-841.
- Andrew L.E, Harrison A. J (2006). *Drying So easy to preserve*, National Centre for Home Food preservation, 989.
- Atteh J.O. (2002). Feed ingredient their composition and idiosyncrasies, principles and practice of livestock feed Manufacturing, 13-25, 1322-147.
- Bakare.A (1995). *Methods of Biochemical analysis of Plant tissues*. Agronomy Department, University of Ibadan. Pp 146-152
- Buchanans R.E and Gibbons N.E. (1974). *The Bergey's manual of determinative bacteriology*, Baltimore, Williams and Wilkin co 8<sup>th</sup> edition.
- Cotran R. S, Vinay K, Tucker C (1999). *Infectious disease, Robins pathologic basis of disease* 6<sup>th</sup> edition. W.B. Sanders company. 380-381.
- David E., Whitfield V. (2000). Solar Drying, Solar Dryer Systems, important resource to improve food preparation. International conference on solar cooking Kimberly South Africa, 1-4.
- Diane A. C (2004). Bacterial disease of Tomatoes. *Agriculture Agric-food Canada*, London Ontario, 1-2.
- Fawole M.O. and Oso B.A. (2004). *Biochemical test, Laboratory Manual of Microbiology*, Spectrum Books ltd Ibadan, 1-55.
- Goldoni J.S., Cavestrir R.C., Kurozawa C., Roca R.C., and Bonassi I.A. (1992). Occurrence of spoilage Bacteria on Tomato frit (*Lycopersicon esculentum*), International Symposium on procession of tomatoes, 1.
- Hartmann H.T, Anton M. K, Vicent E. R, William J. F (1988). *Vegetable crops grown for fruits or seeds. Growth, Development and utilization of cultivated plants Plant science*,. Prentile Hall Career and Technology prentile Hall Inc., 536-550.
- Ihekoronye A.I, Ngoddy P.O. (1985). *Tropical fruits and vegetables. Integrated food science and technology for the tropics. Tropical fruits & vegetables*. Macmillan education Ltd London and Oxford, 306.

Jawetz E, Melnik J.I and Abelberg's. (1991). Spore-forming gram positive bacilli and enterobacteriaceae, *Medical Microbiology*, 19<sup>th</sup> edition. A lange Medical book, 180-214.

Khanthone K. (1992). Introduction to Plant Density. Effect on processing of Tomato Yield and Yield component. ARC Training, 1-2.

Kolawole O.M, Adeyemi B.J, Kayode R.M.O, Ajibola T.B. (2009). The drying effect of colour light frequencies on the nutrient and microbial composition of cassava. *African Journal of Agricultural Research*, Vol. 4(3): 171-177.

Kurt J. L and William E. F. (1989). Identification and Evaluation of quantitative resistance plant disease, Epidemiology, Genetics, Resistance, and Management, Macmillan publishing company, 215-245.

Prescott L.M., Harley J.P., Klein D.A. (2005). Microbiology of food, Microbiology 6<sup>th</sup> edition, Wcbrolum publication Dubuque I., 526, 937-961.

Salawu E.O. (2005). *Diseases, Terminologies in phytopathology*, University of Ilorin Press pp 51-60.

Samson R.A and Van Reenen-Hoekstra, E.S. (1982). Introduction to food-borne fungi, 3<sup>rd</sup> edition. Centraal Bureauvoor Schimmidcultuur Baarn, pp2-89.

Table 1. Average daily temperature of tomato during drying (<sup>0</sup>C)

Box	Frequency range ( $\times 10^{12}$ )Hz	Day 1	Day2	Day 3	Day 4	Day 5	Day 6	Day 7
L Red	384-482	34.5 $\pm$ 1.1 <sup>c</sup>	32.1 $\pm$ 1.3 <sup>b</sup>	31.5 $\pm$ 2.7 <sup>b</sup>	27.2 $\pm$ 3.4 <sup>a</sup>	35.1 $\pm$ 3.3 <sup>c</sup>	28.5 $\pm$ 1.4 <sup>a</sup>	36.2 $\pm$ 1.5 <sup>c</sup>
D Red		34.7 $\pm$ 1.2 <sup>c</sup>	31.0 $\pm$ 2.3 <sup>b</sup>	30.80 $\pm$ 2.4 <sup>b</sup>	27.7 $\pm$ 3.3	35.1 $\pm$ 2.7 <sup>c</sup>	28.8 $\pm$ 1.3 <sup>a</sup>	31.2 $\pm$ 1.7 <sup>b</sup>
L Orange	482-503	34.7 $\pm$ 1.4 <sup>c</sup>	30.9 $\pm$ 1.6 <sup>b</sup>	30.3 $\pm$ 2.3 <sup>b</sup>	26.7 $\pm$ 2.4 <sup>a</sup>	35.8 $\pm$ 2.3 <sup>c</sup>	33.8 $\pm$ 2.9 <sup>b</sup>	29.4 $\pm$ 1.6 <sup>a</sup>
D Orange		34.3 $\pm$ 2.3 <sup>c</sup>	30.7 $\pm$ 1.3 <sup>b</sup>	30.1 $\pm$ 2.6 <sup>b</sup>	26.8 $\pm$ 1.1 <sup>a</sup>	34.6 $\pm$ 3.7 <sup>c</sup>	28.7 $\pm$ 1.3 <sup>a</sup>	31.1 $\pm$ 3.1 <sup>b</sup> <sup>c</sup>
L Yellow	503-520	34.3 $\pm$ 1.1 <sup>c</sup>	30.7 $\pm$ 10.4 <sup>b</sup>	30.9 $\pm$ 1.1 <sup>b</sup>	27.0 $\pm$ 2.1 <sup>a</sup>	35.2 $\pm$ 2.9 <sup>c</sup>	28.0 $\pm$ 1.3 <sup>a</sup>	27.8 $\pm$ 3.2 <sup>a</sup>
D yellow		34.6 $\pm$ 1.3 <sup>c</sup>	31.2 $\pm$ 1.5 <sup>b</sup>	30.7 $\pm$ 2.3 <sup>b</sup>	27.3 $\pm$ 2.3	35.2 $\pm$ 2.7 <sup>c</sup>	28.3 $\pm$ 1.9 <sup>a</sup>	28.8 $\pm$ 3.7 <sup>a</sup>
L Green	520-610	34.2 $\pm$ 1.6 <sup>c</sup>	31.0 $\pm$ 1.0 <sup>b</sup>	31.7 $\pm$ 2.8 <sup>b</sup>	26.8 $\pm$ 3.3 <sup>a</sup>	34.4 $\pm$ 2.1 <sup>c</sup>	27.8 $\pm$ 2.7 <sup>a</sup>	27.6 $\pm$ 1.5 <sup>a</sup>
D Green		34.0 $\pm$ 1.5 <sup>c</sup>	31.5 $\pm$ 1.4 <sup>b</sup>	31.9 $\pm$ 2.7 <sup>b</sup>	27.2 $\pm$ 3.4 <sup>a</sup>	34.9 $\pm$ 2.4 <sup>c</sup>	28.2 $\pm$ 2.7 <sup>a</sup>	31.6 $\pm$ 2.3 <sup>b</sup>
L Blue	610-659	34.5 $\pm$ 1.4 <sup>c</sup>	31.3 $\pm$ 1.3 <sup>b</sup>	31.6 $\pm$ 2.3 <sup>b</sup>	27.0 $\pm$ 3.3 <sup>a</sup>	34.4 $\pm$ 1.1 <sup>c</sup>	28.5 $\pm$ 2.8 <sup>a</sup>	34.2 $\pm$ 3.3 <sup>a</sup>
D Blue		34.3 $\pm$ 1.2 <sup>c</sup>	31.2 $\pm$ 1.1 <sup>b</sup>	31.4 $\pm$ 2.1 <sup>b</sup>	31.6 $\pm$ 2.2 <sup>b</sup>	34.4 $\pm$ 3.4 <sup>c</sup>	28.2 $\pm$ 3.3 <sup>a</sup>	28.1 $\pm$ 2.3 <sup>b</sup>
L Purple	65-769	34.3 $\pm$ 2.3 <sup>bc</sup>	30.7 $\pm$ 2.2 <sup>b</sup>	30.0 $\pm$ 1.3 <sup>b</sup>	27.3 $\pm$ 2.4 <sup>a</sup>	34.6 $\pm$ 3.4 <sup>c</sup>	28.7 $\pm$ 1.1 <sup>a</sup>	32.7 $\pm$ 1.3 <sup>b</sup>
D Purple		33.6 $\pm$ 2.2 <sup>c</sup>	31.2 $\pm$ 1.5 <sup>b</sup>	31.0 $\pm$ 1.5 <sup>b</sup>	27.5 $\pm$ 1.3 <sup>a</sup>	34.6 $\pm$ 2.2 <sup>c</sup>	28.2 $\pm$ 2.4 <sup>a</sup>	27.7 $\pm$ 1.3 <sup>a</sup>
White	430-750	35.0 $\pm$ 1.9 <sup>c</sup>	32.0 $\pm$ 1.1 <sup>b</sup>	30.8 $\pm$ 1.2 <sup>b</sup>	27.2 $\pm$ 3.2 <sup>a</sup>	35.0 $\pm$ 2.3 <sup>c</sup>	33.8 $\pm$ 3.2 <sup>bc</sup>	29.0 $\pm$ 2.5 <sup>a</sup>
Black		34.7 $\pm$ 1.2 <sup>c</sup>	30.7 $\pm$ 1.9 <sup>b</sup>	31.8 $\pm$ 1.2 <sup>b</sup>	27.5 $\pm$ 2.1 <sup>a</sup>	29.0 $\pm$ 2.3 <sup>a</sup>	29.0 $\pm$ 1.5 <sup>a</sup>	31.2 $\pm$ 2.5 <sup>b</sup>
L Brown	<430	34.3 $\pm$ 1.1 <sup>c</sup>	31.7 $\pm$ 2.4 <sup>b</sup>	31.0 $\pm$ 1.1 <sup>b</sup>	26.8 $\pm$ 3.4 <sup>a</sup>	35.3 $\pm$ 3.5 <sup>c</sup>	28.5 $\pm$ 1.0 <sup>a</sup>	33.4 $\pm$ 2.1 <sup>bc</sup>
D Brown		33.5 $\pm$ 1.2 <sup>c</sup>	31.6 $\pm$ 1.1 <sup>b</sup>	31.5 $\pm$ 1.4 <sup>b</sup>	27.0 $\pm$ 3.4 <sup>a</sup>	34.7 $\pm$ 1.3 <sup>c</sup>	27.8 $\pm$ 1.1 <sup>a</sup>	34.6 $\pm$ 1.3 <sup>c</sup>
Control	430-750	36.0 $\pm$ 1.4 <sup>c</sup>	32.0 $\pm$ 3.2 <sup>b</sup>	31.5 $\pm$ 1.3 <sup>b</sup>	27.3 $\pm$ 2.4 <sup>a</sup>	34.9 $\pm$ 1.5 <sup>c</sup>	29.7 $\pm$ 1.9 <sup>a</sup>	29.6 $\pm$ 2.3 <sup>a</sup>

Values are means of six replicate  $\pm$  standard error of mean (SEM); Values with different letters are significantly different at  $p < 0.05$ .

Table 2. Proximate composition and Vitamin C content of tomato dried under different colour frequencies of light

BOX	Frequency range ( $\times 10^{12} \text{H}_3$ )	Moisture (%)	crude protein (%)	Ash (%)	Crude fat (%)	crude fibre (%)	CHO (%)	Vitamin C (mg/kg)
L Red		97.55 <sup>abc</sup>	13.55 <sup>d</sup>	47.10 <sup>f</sup>	0.81 <sup>a</sup>	10.94 <sup>ab</sup>	27.63 <sup>b</sup>	17.85 <sup>e</sup>
D Red	384-482	96.55 <sup>abc</sup>	12.69 <sup>cd</sup>	28.20 <sup>bcd</sup>	0.62 <sup>a</sup>	13.50 <sup>cd</sup>	44.98 <sup>h</sup>	22.30 <sup>f</sup>
L Orange		98.25 <sup>c</sup>	13.13 <sup>d</sup>	27.80 <sup>bcd</sup>	0.77 <sup>a</sup>	11.05 <sup>ab</sup>	47.25 <sup>h</sup>	32.60 <sup>a</sup>
D Orange	482-503	96.75 <sup>abc</sup>	13.57 <sup>d</sup>	26.00 <sup>b</sup>	0.69 <sup>a</sup>	17.20 <sup>h</sup>	42.55 <sup>fg</sup>	2.85 <sup>a</sup>
L Yellow		97.65 <sup>abc</sup>	11.59 <sup>c</sup>	30.50 <sup>de</sup>	0.71 <sup>a</sup>	16.60 <sup>fg</sup>	40.60 <sup>ef</sup>	24.35 <sup>g</sup>
D yellow	503-520	97.10 <sup>abc</sup>	12.69 <sup>cd</sup>	33.00 <sup>e</sup>	0.88 <sup>a</sup>	15.40 <sup>ef</sup>	38.05 <sup>de</sup>	9.35 <sup>c</sup>
L Green		98.10 <sup>c</sup>	13.78 <sup>d</sup>	18.40 <sup>a</sup>	0.85 <sup>a</sup>	15.60 <sup>f</sup>	51.37 <sup>i</sup>	15.90 <sup>e</sup>
D Green	520-610	97.35 <sup>abc</sup>	13.56 <sup>d</sup>	27.10 <sup>bc</sup>	0.91 <sup>a</sup>	12.30 <sup>bc</sup>	46.15 <sup>h</sup>	21.00 <sup>f</sup>
L Blue		97.70 <sup>abc</sup>	9.84 <sup>b</sup>	29.00 <sup>bcd</sup>	0.94 <sup>a</sup>	25.30 <sup>i</sup>	34.91 <sup>cd</sup>	5.90 <sup>b</sup>
D Blue	610-659	96.95 <sup>abc</sup>	12.68 <sup>cd</sup>	30.30 <sup>de</sup>	0.97 <sup>a</sup>	16.00 <sup>fg</sup>	40.05 <sup>ef</sup>	6.45 <sup>b</sup>
L Purple		98.35 <sup>c</sup>	12.61 <sup>cd</sup>	25.50 <sup>b</sup>	0.92 <sup>a</sup>	18.90 <sup>i</sup>	42.05 <sup>efg</sup>	24.60 <sup>g</sup>
D Purple	659-769	97.80 <sup>bc</sup>	11.55 <sup>c</sup>	32.00 <sup>e</sup>	0.87 <sup>a</sup>	22.40 <sup>k</sup>	33.18 <sup>c</sup>	6.90 <sup>b</sup>
L Brown		96.90 <sup>abc</sup>	13.75 <sup>d</sup>	36.20 <sup>f</sup>	0.81 <sup>a</sup>	11.20 <sup>ab</sup>	33.03 <sup>de</sup>	17.70 <sup>e</sup>
D Brown	<430	96.15 <sup>abc</sup>	13.30 <sup>d</sup>	30.20 <sup>de</sup>	0.87 <sup>a</sup>	16.30 <sup>fg</sup>	39.51 <sup>ef</sup>	13.05 <sup>d</sup>
Black		96.60 <sup>abc</sup>	12.66 <sup>cd</sup>	54.30 <sup>h</sup>	0.88 <sup>a</sup>	14.20 <sup>de</sup>	17.95 <sup>a</sup>	42.55 <sup>h</sup>
White		95.88 <sup>a</sup>	13.55 <sup>d</sup>	47.05 <sup>g</sup>	0.85 <sup>a</sup>	18.94 <sup>j</sup>	19.60 <sup>a</sup>	12.65 <sup>d</sup>
Control	430-750	97.00 <sup>abc</sup>	4.79 <sup>a</sup>	32.00 <sup>e</sup>	0.85 <sup>a</sup>	10.80 <sup>a</sup>	51.30 <sup>i</sup>	20.50 <sup>f</sup>
Fresh Tomato		95.80	1.53	7.00	0.50	8.00	82.97	24.00

**Key:** L = Light; D = Dark

Different letters in the same column indicate significant difference between the different frequencies.

Values with the same letters in the same column are not significantly different at  $P < 0.05$ .

Values are means of two replicates.

Table 3. Distribution of bacteria and fungi isolates in tomato dried under different colour frequencies of light

Box	Frequency Range ( $\times 10^{12}$ )Hz	A1	A2	A3	A4	A5	A6	A7	A8
L Red	384-482	+Ve	-Ve	+Ve	-Ve	-Ve	+Ve	-Ve	+Ve
D Red		+Ve	-Ve	-Ve	-Ve	-Ve	-Ve	+Ve	+Ve
L Orange	482-503	+Ve	-Ve	-Ve	-Ve	-Ve	+Ve	-Ve	-Ve
D Orange		-Ve	+Ve	+Ve	-Ve	+Ve	-Ve	-Ve	-Ve
L Yellow	503-520	-Ve	-Ve	+Ve	+Ve	-Ve	+Ve	+Ve	-Ve
D yellow		+Ve	+Ve	-Ve	-Ve	+Ve	-Ve	-Ve	+Ve
L Green	520-610	-Ve	-Ve	-Ve	+Ve	-Ve	+Ve	-Ve	+Ve
D Green		-Ve	-Ve	-Ve	-Ve	+Ve	-Ve	-Ve	+Ve
L Blue	610-659	+Ve	-Ve	+Ve	-Ve	-Ve	-Ve	+Ve	-Ve
D Blue		-Ve	-Ve	-Ve	+Ve	-Ve	+Ve	-Ve	-Ve
L Purple	659-769	+Ve	+Ve	+Ve	-Ve	+Ve	-Ve	-Ve	-Ve
D Purple		-Ve	-Ve	+Ve	-Ve	-Ve	-Ve	+Ve	-Ve
White	430-750	-Ve	-Ve	+Ve	-Ve	+Ve	-Ve	-Ve	+Ve
Black		-Ve	-Ve	-Ve	-Ve	+Ve	-Ve	+Ve	-Ve
L Brown	430	-Ve	-Ve	-Ve	+Ve	-Ve	+Ve	-Ve	+Ve
D Brown		+Ve	-Ve	-Ve	+Ve	-Ve	+Ve	+Ve	-Ve
Control	430-750	-Ve	+Ve	-Ve	+Ve	+Ve	-Ve	-Ve	+Ve

**Key:**

D = Dark,

L = Light

A1= *Erwinia carotovora*,

A2= *Proteus species*

A3= *Bacillus species*

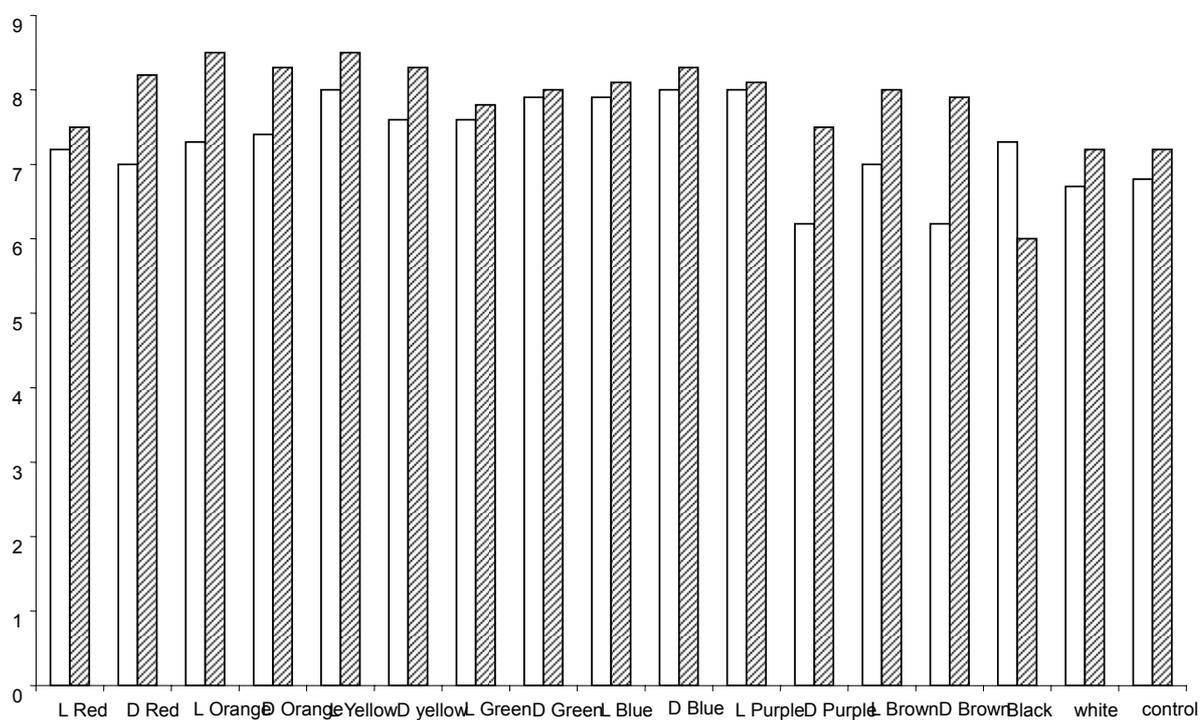
A4= *Micrococcus luteus*

A5= *Aspergillus Species*

A6= *Aspergillus niger*,

A7= *Rhizopus stolonifer*

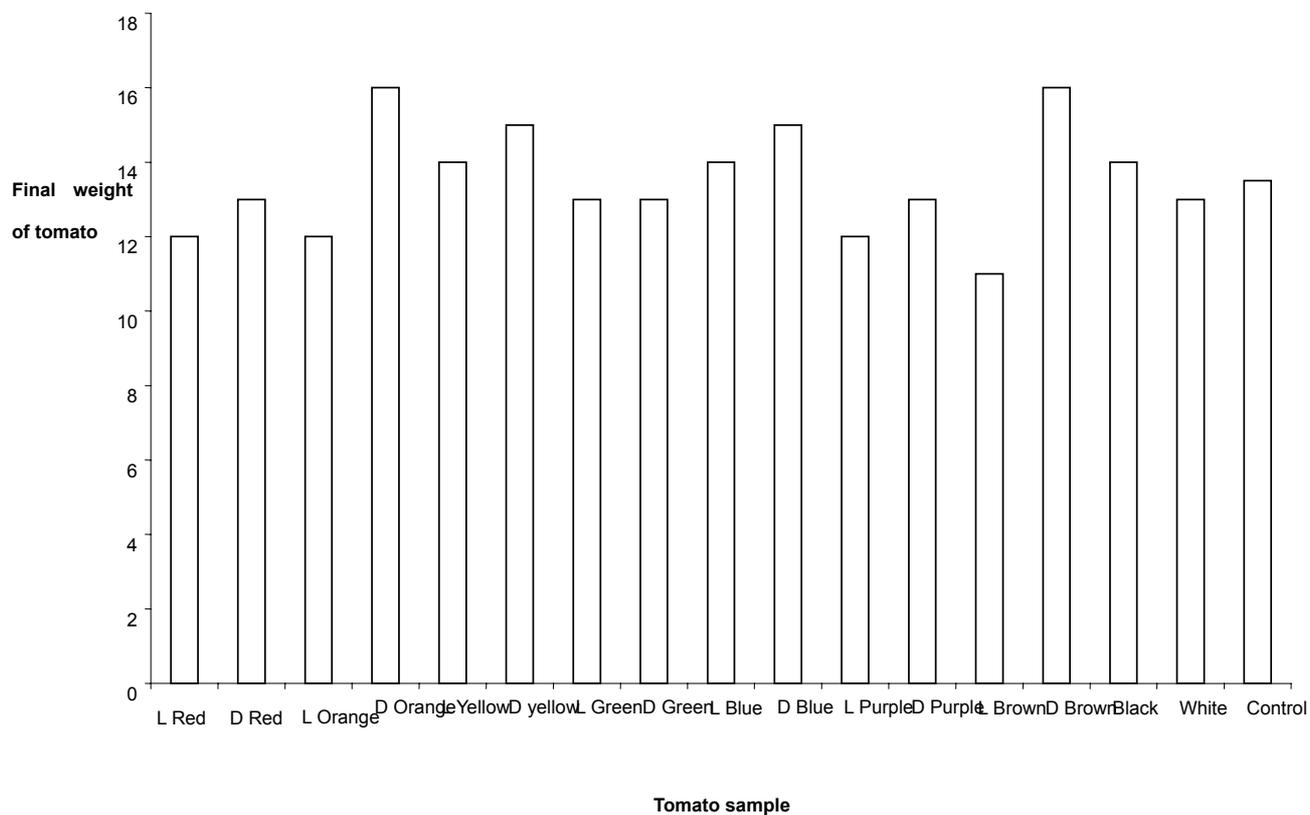
A8= *Penicillium chrysogenum*.



**Colour frequencies**

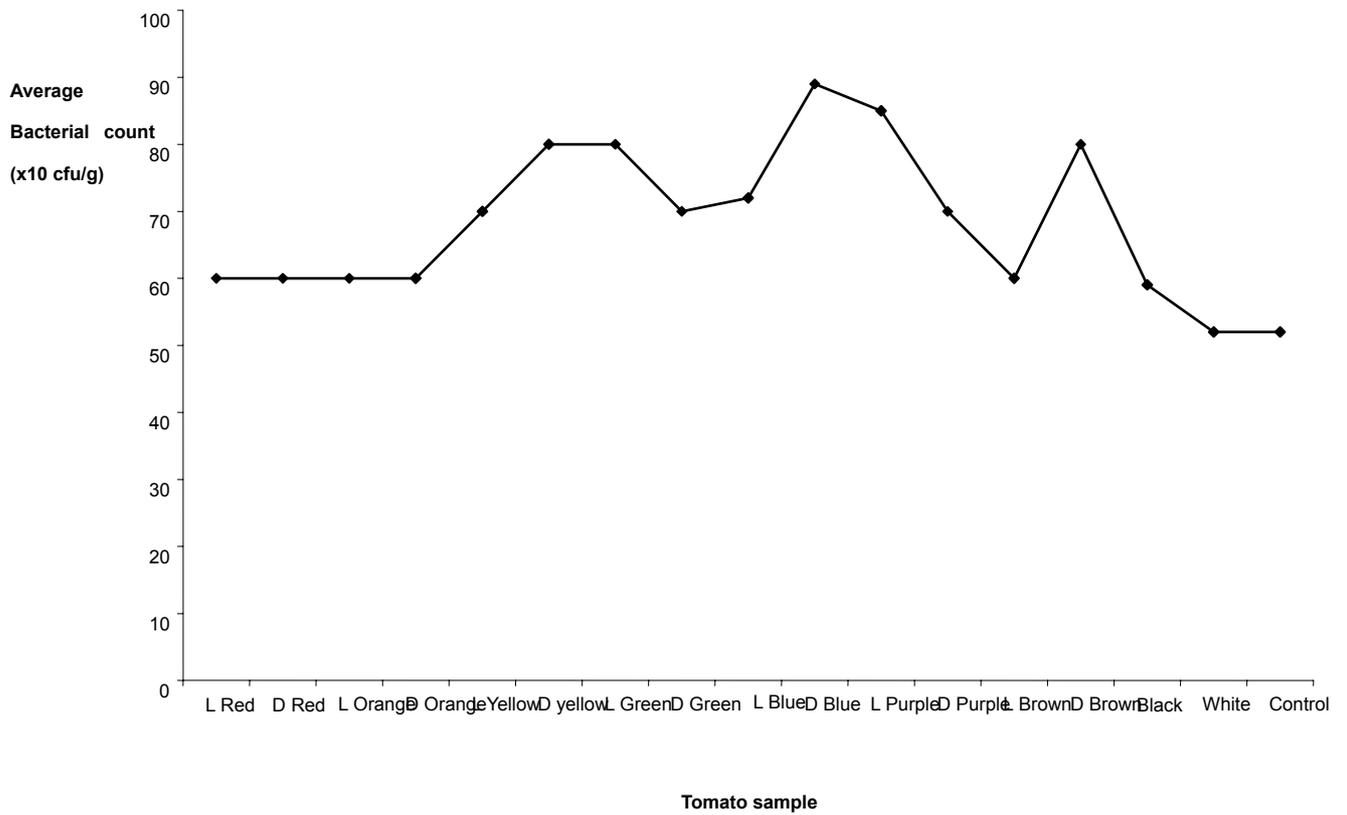
Key: ○ - Initial pH; ◐ - Final pH

Figure 1. The pH of tomato during drying



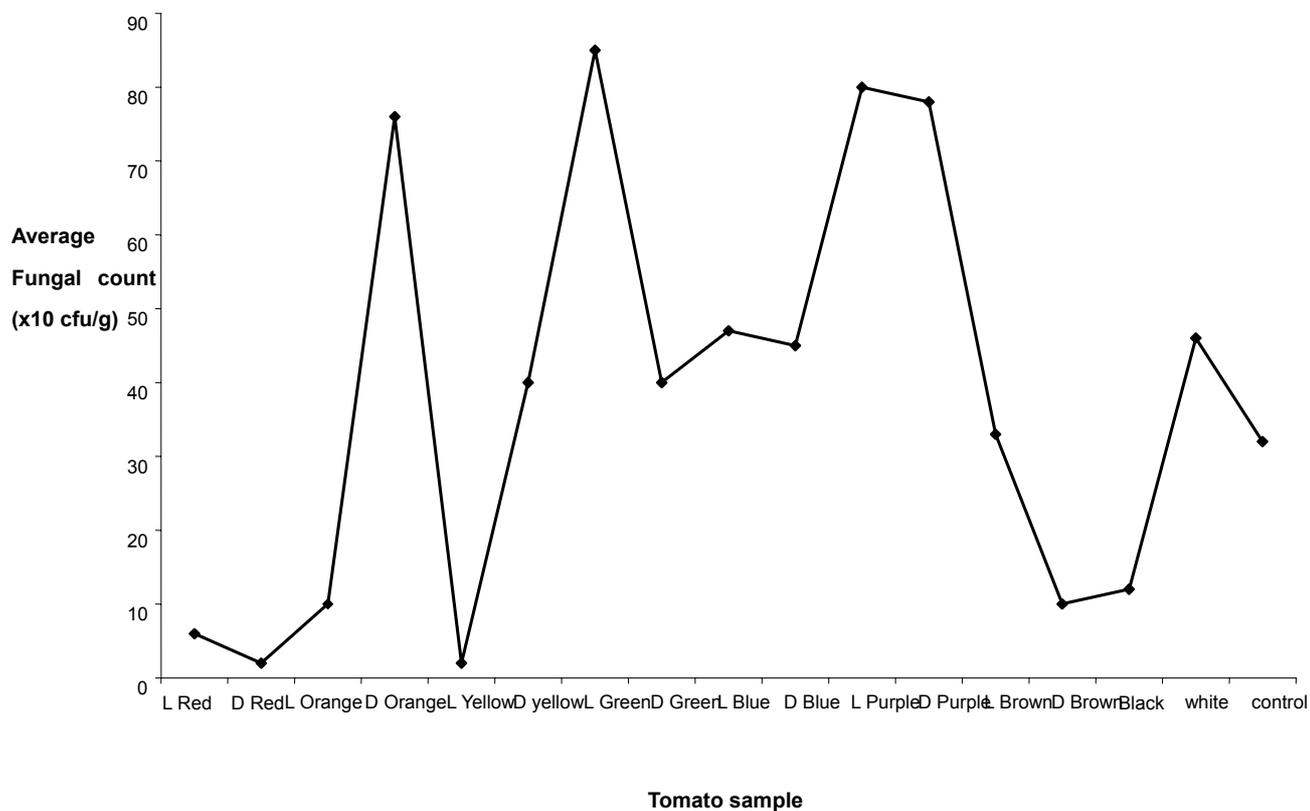
Key: D = Dark; L = Light ; Each sample had initial weight of 500g

Figure 2. Final weight of tomato after drying



Key  
D = Dark,  
L = Light

Figure 3. Total Bacterial Count Of Tomato During Drying



**Key:** D = Dark; L = Light

Figure 4. Fungal count of tomato during drying