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Comparative Study of Organic and Conventionally Produced Tomatoes of the Selected area of Dhankuta, Nepal

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Abstract

The quality value of conventional tomatoes with organic tomatoes are studied in selected area of Dhankuta, Nepal. The several components, including color, size, viscosity, surface tension, refractive index, juice contents, metal ions (Mg, Ca, K, Zn, Ni, Fe and Cu), firmness and storage capacity contents are compared in processing tomatoes grown by conventional production systems and organic production systems.

***Keywords**: Surface tension, Viscosity, Refractive index, Conventional tomatoes, Organic tomatoes*

Introduction

Tomato is one of the popular and most consumed vegetable in the World. It is tasty and easily digestible and its bright color stimulates appetite. As a result, it is grown in the backyard of most people's home. It is consumed as salad with other leafy vegetables, in sandwiches, and as stewed, fried, and baked singly or in combination with other vegetables. It is an essential ingredient in pizza, pasta, hamburger, hot dogs, and other foods. It is also rich in nutrients and calories. It is a good source of Fe and vitamin C. Consumption of tomatoes and its products can significantly reduce the risk of developing of colon, rectal, and stomach cancer. Recent studies suggest that tomatoes contain the antioxidant lycopene, the most common form of carotenoid, which markedly reduces the risk of prostate cancer[1]. Because the mineral composition of tomato depends on the amount and type of nutrients taken from the growth medium, such as soil, it is necessary that adequate amount of nutrients should be available for the production and nutrient content of tomatoes. While inadequate amount of nutrient availability can show deficiency symptom and influence the yield and quality of tomato, higher level of nutrients, such as N, can also reduce tomato yield by producing excess biomass at the cost of fruits and lodging of entire plant in the ground, which makes harvest of fruits more difficult. The residual N in the soil left after harvest can leach from the soil profile and contaminate groundwater, thereby degrading water quality and wasting the amount and cost of fertilizer applied. Similarly, excess availability of some nutrients, such as B and Mn, can cause toxic effect. Therefore, rate and type of nutrients applied in the form of fertilizers should be adjusted after analyzing the nutrient contents of soil and plant samples.

Tomatoes farming depend up on atmospheric conditions, soil environment and farming process etc. The tomato is the second most widely consumed vegetable after the potatoes [2].

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The tomato's attractive color and flavor have made it a dietary staple in many parts of the World. Nutritional considerations also bring the tomato to the forefront. In the human diet, it is an important source of micronutrients, certain minerals (notably potassium) and carboxylic acids, including ascorbic, citric, malic, formic and oxalic acids [3-4]. Tomatoes and tomato products are rich in food components that are antioxidant and considered to be a source of carotenoids, in particular lycopene and phenolic compounds[5-6] but low in fat and calories, as well as being cholesterol-free. Most importantly, tomato consumption has been shown to reduce the risks of cardiovascular disease and certain types of cancer, such as cancers of prostate, lung and stomach [7].

The health promoting benefits of tomatoes and tomato products have been attributed mostly to the significant amount of lycopene contained. The results of various studies suggest that lycopene plays a role in the prevention of different health issues, cardiovascular disorders, digestive tract tumors and in inhibiting prostate carcinoma cell proliferation in humans [8].

The benefits of tomatoes and tomato products have been attributed mostly to the significant amount of lycopene contained, which constitutes 80 to 90% of the total carotenoid content present in tomatoes. Increased interest in organic tomato production is imposed by the need to evaluate the quality and nutritional value of organic tomato. One major problem in comparative studies might be that genuine organic and conventional production systems differ in many factors and that a simple measurement of food composition does not reflect its quality. Other scientists have argued that a valid comparison of nutritional quality would, for example, require that the same cultivars are grown at the same location, in the same soil and with the same amounts of nutrients, conditions which all normally differ between the two systems [9]. Organic tomatoes achieved higher prices than conventional ones, because these products are often linked to sew up the environment, better quality (taste, storage) and most people believe that they are healthier. Moreover, research results on the effects of organic and conventional production on quality sometimes are contradictory. In terms of quality, some studies report better taste, higher vitamin C contents and higher levels of other quality related compounds for organically grown products [10-11], whereas several other studies have found the opposite or no differences in quality characteristics between organically and conventionally grown fruits and vegetables[11]. The identification of cultivars with high nutritive value, represent a useful approach to select tomatoes cultivars with better health-promoting properties. During tomato fruit ripening, a series of quantitative and qualitative changes take place, changing tomato flavor and aroma volatile profiles[12]. Generally, two types of tomatoes farming are observed in the Planet Earth, one is organic farming and the other is conventional farming. In Nepal, organic farming is going to be popular than conventional farming. In this study, the research area for organic and conventional farming for tomatoes are selected in Dhankuta Municipility, Karmitar -5, Dhankuta. The aim of this study was to compare yield and quality parameters in different tomato cultivars derived from organic and conventional growing systems.

Experimental Methods

One popular variety of tomatoes' seeds was bought from Dhankuta market as for the samples. The seeds were provided to K.B. Shrestha, the staff of Dhankuta Multiple Campus, Dhankuta to grow in the campus garden of Dhankuta Multiple Campus. The farming was done by two ways: Organic tomatoes farming and conventional tomatoes farming. For conventional farming, the seeds of tomatoes were

planted by using urea, potash and DAP whereas for organic farming, the seeds of tomatoes were planted by using goat manure and plant leaves etc. The samples were ready for analysis after 3 months of plantation. The edible fruit of tomatoes were the samples for analysis of different parameters. The samples were tested in different laboratories (Chemistry Lab. in Dhankuta Multiple Campus, Mahendra Morang Adarsh Multiple Campus, Biratnagar and Central Food Research Lab., Babarmahal, Kathmandu, Nepal). In order to measure different parameters like surface tension, viscosity and refractive index, amount of metals like P, Mg, K, Ca and heavy metals like Zn, Ni, Pb, Fe as well as the size of tomatoes, color, juice contents etc. for both conventional and organic tomatoes, it was taken equal mass (0.5 kg) of organic tomatoes and conventional tomatoes. First, organic tomatoes were kept in a juice preparing instrument (blender container) and covered with lid. The blender was started with low speed. Finally, the paste of organic tomatoes and conventional tomatoes was prepared separately one by one. The paste was kept in dry clean beaker and added equal amount of distilled water in both beakers. The tomatoes juice was filtered with tea filter in separate beakers. The residue was removed and filtrate was again filtered with filter paper, then obtained filtrate was not seen pure clear juice. By adding 0.1 N HCl in both filtrate of two different samples (conventional and organic) tomatoes, the solutions became clear which was ready for measuring the viscosity and surface tension of both tomatoes juices.

Density measurements

In order to see the viscosity and surface tension of juice of organic tomatoes and conventional tomatoes, the density is essential to calculate. The room temperature was found to be 25 °C. The density of a liquid was conveniently measured by means of a density bottle. A density bottle is a small bottle of 25 cm^3 capacity with a capillary stopper fitted into its mouth. It has a round bottomed type of glass vessel.

Surface tension measurements

Stalagmometer was used to determine the surface tension of a liquid. It was designed by Traube and consists of a pipette with a capillary outflow tube, the end of which is flat end out. This is done to give a larger dropping surface. Before using the Stalagmometer, it was first carefully washed with a solution of chromic acid and the distilled water. Finally, it was washed with acetone and dried. It must be borne in mind that the tip of lower end should not come in contact with hand, desk or some other thing, as it will be contaminated with a trace of grease. Slight traces of grease will alter the size of the drops, hence their number. The stalagmometer should be held vertical and not shaken because otherwise the drop will fall out even before attaining its maximum size.

Viscosity measurements

The apparatus generally used for the determination of the viscosity of liquids is known as Ostwald's Viscometer, designed by Ostwald. The apparatus was cleaned and the experiment repeated with water, taking about the same volume. The time flow of water was recorded. Knowing the value of viscosity coefficient of water at the temperature of the experiment, the absolute viscosity coefficient of the given liquid can be found.

Refractive Index Measurements

A refractometer is a laboratory or field device for the measurement of an index of refraction (Refractometry). The index of refraction is calculated from Snell's law and can be calculated from the

composition of the material using the Gladstone–Dale relation. The data of refractive index was measured.

For Determination of Metals in AAS

For determination of metals in Atomic Absorption Spectroscopy **(**AAS), equal weight of organic tomatoes and conventional tomatoes were taken with help of electronic balance. The samples were chopped into small pieces with knife. Then, the homogeneous paste was prepared. 40 gm of each paste was kept into crucible. The crucible was put into the oven up to (100°C to 105°C) for 24 hours to make it complete dry. The dried samples were kept into muffler furnace for 12 hours at 550 °C in order to get ash. The ash was dissolved into 1: 1 HCl of 10 ml volume was maintained up to mark which was the mother solution. The analyze sample was prepared from mother sample and calculated the different metals in both tomatoes samples.

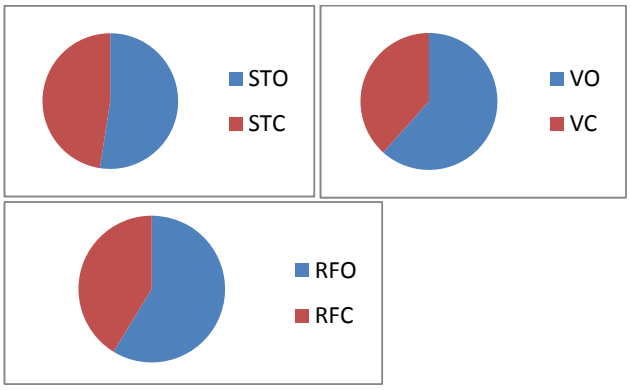
Results and Discussion

The following results have been obtained from the experiments:

- Number of drops for conventional tomatoes juice: 113
- Number of drops for organic tomatoes juice: 116
- Surface tension in conventional tomatoes: 97.53 dyne/cm
- Surface tension in organic tomatoes: 105.37 dyne/cm
- Time flow for conventional tomatoes juice: 33 Sec
- Time flow for conventional tomatoes juice: 45 Sec
- Viscosity in conventional tomatoes: 2.11 milipoise
- Viscosity in organic tomatoes: 3.39 milipoise
- Refractive index in conventional tomatoes: 2.7 Brix
- Refractive index in organic tomatoes: 3.0 Brix
- Mg in conventional tomatoes: 6.71 mg/100gm
- Mg in organic tomatoes: 9.95 mg/100gm
- Ca in conventional tomatoes: 6.73 mg/100gm
- Ca in organic tomatoes: 8.75 mg/100gm
- K in conventional tomatoes: 159.19 mg/100gm
- K in organic tomatoes: 261.77 mg/100gm
- Zn in conventional tomatoes: 0.008 mg/100gm
- Zn in organic tomatoes: 0.009 mg/100gm
- Fe in conventional tomatoes: 0.88 mg/100gm
- Fe in organic tomatoes: 0.51 mg/100gm
- Ni in conventional tomatoes: 29.36ppb (micro gram per kg)
- Ni in organic tomatoes: 57.27ppb (micro gram per kg)
- Cu in conventional tomatoes: 72.83ppb (micro gram per kg)
- Cu in organic tomatoes: 180.63ppb (micro gram per kg)
- Pb in conventional tomatoes not detected

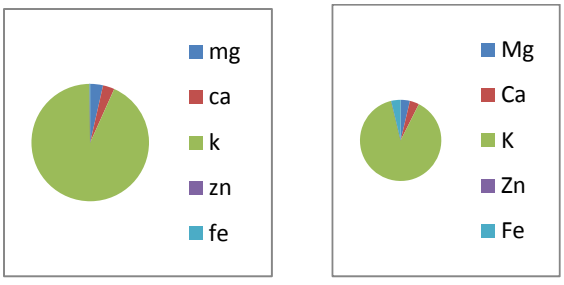
- Pb in organic tomatoes not detected
- Juice contents in conventional tomatoes: Medium
- Juice contents in organic tomatoes: Maximum
- Storage capacity in conventional tomatoes: 5 days
- Storage capacity in organic tomatoes: 7 days
- Firmness in organic tomatoes: More
- Firmness in conventional tomatoes: Less
- Vitamin C in organic tomatoes: 33 miligram per 100 grams
- Vitamin C in conventional tomatoes: 21 miligram per 100 grams

The pie chart representation for comparison between the organic and conventional tomatoes in viscosity, surface tension and refractive index are as follows:



STO= surface tension of organic tomatoes, STC =surface tension of conventional tomatoes, VO = viscosity of organic tomatoes, VC= viscosity of conventional tomatoes, RFO= refractive index of organic tomatoes, RFC= Refractive index of conventional tomatoes

Similarly, the pie chart representation for comparison between the organic and conventional tomatoes in metals are as follows:



organic tomatoes **conventional tomatoes**

Our organic tomatoes achieved significantly greater concentrations of minerals. Such greater concentrations of minerals were found in the literature for organic tomatoes [13]. We have found

significantly greater concentrations of K, Ca, Cu, Ni, Zn and Mg in organic tomatoes and greater concentrations of Fe in conventionally grown tomatoes. Our findings matched with the literature[14]. The calcium content in the organic tomatoes (8.75 mg/100 g) in our data found to be higher than in conventional tomatoes (6.73 mg/100 gm). But the calcium concentrations for organic tomatoes (15.977 23.13 mg/100 g) were higher in the reported literature [15]. The lead content of tomato fruit, in general, was very low and ranges depending on the hybrid and the methods of production from 0.07 to 0.19 mg/ 100g [16]. But we found nil result of Lead in both tomatoes. It was also found that fertilizer that was rich in soluble nitrogen (N) could cause a decrease in the ascorbic acid content. We can say that organic tomatoes were dark red color than conventional tomatoes due to presence of more carotene in organic production tomatoes than conventional production tomatoes. The juice of organic tomatoes has found to be more surface tension than conventional tomatoes juice due to more force of interaction between metals or other particles present in the organic tomatoes juice. So, number of drops of organic tomatoes is minimum than conventional production tomatoes juice and the nature of juice of organic tomatoes has found to be more viscous than conventional tomatoes juice due to presence of more amount of minerals, and some other constituent particles. The organic production tomatoes juice was more concentrated than conventional production tomatoes juice. So, it moves slowly due to more retarding force present in organic production juice. Organic and inorganic fertilizer also influences the element presence in the tomatoes. Organic production increases yield and builds soil quality. The organically farmed soils exhibited higher potential denitrification rates, greater denitrification efficiency, higher levels of organic matter, and greater microbial activity than the conventionally farmed soils. Many citations from literature confirm that tomatoes coming from organic cultivation procedures present higher vitamin C content than fruits from conventional cultivation[17]. It was also found that fertilizer that was rich in soluble nitrogen (N) could cause a decrease in the ascorbic acid content, probably for indirect reasons, since the nitrogen supply increased the plants' leaf density, which promoted shading over the fruits. Differences between organic and conventional tomatoes can be explained by the fertilizer used in both cases. Organic farming does not use nitrogenous fertilizers; as a result, plants respond by activating their own defense mechanisms, increasing the levels of all antioxidants. Tomato fruits from organic farming experienced stressing conditions that resulted in oxidative stress and the accumulation of higher concentrations of soluble solids as sugars and other compounds contributing to fruit nutritional quality such as vitamin C and phenolic compounds[18]. Organic tomatoes contained the maximum amount of K, Ca, Mg, Cu, Zn and Ni than conventional tomatoes. The amount of Fe in organic tomatoes was less than conventional tomatoes. Pb could not be detected. Minerals depend upon the nature of soil, method of farming and timing and nature and condition of environment. Organic and inorganic fertilizer also influence the element present in the tomatoes. While adding the urea, potash like different chemicals in the soil then the pH value increases and hence the amount of Zn, Mn, Ni etc., decreases in conventional tomatoes. By adding the compost or goat manure in the soil then the pH value decreases and hence the amount of Ca, Mg and K etc. increases in organic tomatoes.

Conclusions

The following conclusions have been drawn from the above results and discussion. Potassium, calcium and magnesium are present in high quantity in organic production tomatoes than conventional tomatoes. The Iron was present low in organic production tomatoes than conventional production tomatoes. Zinc, Nickel, Copper were present in high in organic production tomatoes than conventional production tomatoes. Vitamin C was present high in organic production tomatoes than conventional

production tomatoes. Pb was not detected in both tomatoes sample. The size of organic tomatoes was found to be less than conventional tomatoes. Vitamin C was present high in organic production tomatoes than conventional production tomatoes. Pb was not detected in both tomatoes sample. The size of organic tomatoes was found to be less than conventional tomatoes. The surface tension and viscosity value of organic tomatoes juice was found to be higher value than conventional tomatoes juice. The refractive index value was higher in organic tomatoes juice than conventional tomatoes juice. Hence it can be concluded that organic tomatoes contain more nutritional value than conventional tomatoes and also this study will be practical importance to vegetable growers, consumers' agricultural scientific community including policy makers in Nepal for further studies

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