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Effect of Ripening on the Proximate and Some Biochemical Composition of a Local Tomato Cultivar (*Nadaffreta*) Grown at Lake Alau Region of Borno State

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Abstract: The study investigated the effects of ripening on the proximate and some biochemical compositions of a local tomato cultivar (*Nadaffreta*) grown at Lake Alau region of Borno state. Significant ($P<0.05$) decrease was observed in the total carbohydrate and organic acids possibly due to increase respiration and metabolism, respectively. Reducing sugars and protein increased significantly ($P<0.05$) due to increased breakdown of storage carbohydrates and accumulation of enzymes for ripening ,respectively while ascorbic acid was poorly retained indicating poor fruit quality and nutritive value of the four ripening stages, the breaker stage seemed to be peak of metabolic and enzymic activities, since electrolytes were found to be at maximum at this stage. The whole process however, did not show any difference on the moisture content.

Key words: Tomato cultivar, ripening, biochemical composition, proximate

INTRODUCTION

Fruits and vegetables constitute one of the major food item in the tropics and are the main sources of many vitamins and minerals[1]. Tomato (*Lycopersion escutentum*) belongs to the family of salanaceae and was introduced into Nigeria in the 18th century by the Europeans[2]. Chemical analysis reveals that sugars and organic acids make a major contribution to the total dry solids[3]. The sugars are mostly glucose and fructose and constitute about 65% of total soluble solids in expressed fruit juice[4]. whereas the acids are mostly malic and citric acids[3]. These constituents are the major energy constituents of the tomato fruit, 100 g of raw tomato contain about 20 calories. Both sugar and acids contribute to taste and flavour of fruits[5,6]. Although the vitamins only account for a small portion of the total dry matter, they are highly significant from the nutritional point of view. About 10 vitamins have been isolated from the tomato fruit, with vitamins A, B and C being the major.

Minerals commonly found in tomato fruit are K>Ca>Mg> and P and may reach to 8% of the dry matter[3].

Most of these chemical constituents and quality attributes of the tomato fruit are affected by genotype, growing conditions, disease and post harvest history[7].There is tremendous variation among tomato genotypes for pH, titrable Acidity, flavour, vitamins and colour.

The conversion of a tomato fruit mature green to fully ripe red involves dramatic changes in colour, sugars and acids and tomato texture. These changes depend on a well coordinated and regulate alteration in metabolism and gene expression involving majority of cells in the fruit which have a dramatic effect on fruit quality[3].

This study is therefore an attempt to investigate the effect of ripening on some biochemical compositions of a particular local tomato cultivar (*Nadaffreta*) grown at the Lake Alau region of Bomo state.

MATERIALS AND METHODS

The tomato cultivar with the local name *Nadaffreta* was collected from the Lake Alau tomato farm at its various ripening stage as described by Davies and Hobson[3] these stages include; green, breaker, pink and red. The period of collection was between March of April 1999. The fruits were authenticated by a Botanist in the Biological Science Department, University of Maiduguri. Samples were immediately assayed.

Analytical method: The following parameters were assayed; moisture and ash, total carbohydrate by proximate difference, total protein by Kjeldlal distillation method[8], reducing sugars were determined by Asatoor and King[9]; titrable acidity by titrimetric method, inorganic ion K^+ by flame photometric method while Ca^{2+} and Mg^{2+} were titrimetrically determined.

Statistical analysis: Test for significance was carried out by one-way analysis of variation (ANOVA) difference in

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mean within and between using the Sheffe's method at multiple comparisons.

RESULTS AND DISCUSSION

The moisture ranged from 95.3 to 95.4, protein from 0.28 for green to 4.3 red, ash ranged from 0.39 for green to 0.43 for both breaker and red, while Carbohydrate ranged from 2.84 for red to 3.92 for green (Table 1).

The reducing sugar recorded in this study ranged from 0.08 for green to 0.43 for red, Titratable acidity ranged from 1.11 for red to 1.89 for green, while ascobic acid ranged from 0.01 for green to 0.17 for red (Table 2).

Potassium ranged from 2.02 for green to 2.15 for breaker, the differences recorded is not significant. Magnesium recorded a range of 0.34 for green to 0.63 for breaker, while calcium ranged from 0.39 for red to 0.71 for breaker (Table 3).

The moisture and dry matter content did not change significantly as the fruit underwent ripening (Table 1). This agree with finding of Davies and Hobson[3] that the process of ripening has no effect on moisture contents. The high moisture indicates its low total solids or dry matter.

The result of the total carbohydrate content (digestible and non-digestible) showed a gradual significant ($P<0.05$) decrease as the stages of ripening progressed. This decrease might be explained by the increase in respiration at the onset of ripening which rose to a maximum called "climetric peak" and subsequently declined. This increased respiration is associated with massive release of CO_2 and increased mitochondrial electron transport and phosphorylation of ADP to ATP[10]. The carbon source of respiration may include organic acids[11,12].

The protein content was observed to increased significantly ($P<0.05$) with ripening (Table 1). This increase may be explained thus during fruit ripening. Many mRNA are transcribed for the synthesis of enzymes required for the ripening processes[13].

The ash content did not change significantly during ripening. This study showed that ash constitute upto 6% dry matter, supporting the report that fruits are major sources of minerals[1]. There was a consistent gradual significant ($P<0.05$) increase in amounts of reducing sugars as ripening advanced (Table 2).

The increase may be however due to increased breakdown of storage and structural polysaccharides[4,7]. The titratable acidity content was also assayed and was found to decreased with ripening (Table 2). Biale and Young[14] also made similar findings. Davies and Hobson[3] further reported that citric acid and malic acids are the major contributors to fruit acidity and citric acid alone accounts for over half the total titratable acidity in ripe fruits. These acids were observed to play a very important role in Kreb's cycle and are utilized in numerous biosynthetic pathways required for ripening processes[14].

Sugar, acids and their interaction are important to sweetness, sourness and overall flavour intensity in tomatoes[5,6]. Fructose and citric acid are important to sweetness and sourness than glucose and malic acid, respectively. High sugar and relatively high acids are required for best flavours. The variation in taste flavours observed in tomatoes may be due to their variation in amounts of acids and sugars. This is because, Lambeth *et al.*[15] showed that there is tremendous variation among tomato genotype of pH and titratable acidity.

The amount of ascorbic acid was observed to be affected significantly ($P<0.05$) by ripening. It increase

Table 1: Proximate composition of tomatoes at various stages of maturation

	Green	Breaker	Pink	Red
Moisture	95.40±0.89	95.30±0.89	95.30±0.84	95.35±0.59
Carbohydrate	3.92±0.79	3.72±0.59	3.36±0.69	2.84±0.49
Protein	0.28±0.05	0.41±0.07	0.41±0.07	0.43±0.04
Ash	0.39±0.02	0.43±0.07	0.42±0.04	0.43±0.03

All values are ± standard deviation of five replicate determinations

Table 2: Results of some biochemical parameters at various stages of maturation

Parameters	Green	Breaker	Pink	Red
Reducing sugar (mg/100 ml)	0.08±0.04	0.14±0.01	0.21±0.09	0.43±0.00
Titratable acidity (g/100 ml)	1.89±0.07	1.14±0.08	1.21±0.11	1.11±0.06
Ascorbic acid (g/100 ml)	0.11±0.00	0.12±0.05	0.01±0.01	0.17±0.00

Table 3: Some inorganic ions at various stages of maturation

	Green	Breaker	Pink	Red
Potassium (K^+)	2.12±0.02	2.15±0.08	2.12±0.08	2.03±0.05
Magnesium (Mg^{2+})	0.34±0.00	0.63±0.01	0.42±0.03	0.37±0.02
Calcium (Ca^{2+})	0.47±0.01	0.71±0.02	0.55±0.04	0.39±0.01

significantly ($P<0.05$) at the pink stage and fell significantly at red stage (Table 2).

It has been reported that retention of ascorbic acid is an index of quality and nutritive value in fruits and vegetables[16].

Some inorganic ions magnesium (Mg^{2+}), potassium (K^{+}) and calcium (Ca^{2+}) were observed to be significantly ($P<0.05$) higher at breaker stage. They, however, significantly ($P<0.05$) decreased gradually at red stage (Table 3). The presence of such ions might be due to their involvement as enzyme cofactor in ripening metabolic pathways. It is thus highly probable that at breaker stage, the enzymic reactions might have reached their peak and then subsequent decline could be anticipated as evident by decreased levels of proteins and inorganic ions.

In conclusion, the high sugar and acid contents are signs of good taste and flavour. It can be a good source of minerals and ascorbic acid when not full ripe, although a later fall in ascorbic acid content of fully ripe was observed. It can be recommended for both domestic and fresh consumption. Again cross breeding with an ascorbic acid rich and retaining cultivar may produce an excellent specie of high taste, flavour, nutritive value and fruit quality.

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