



(RESEARCH ARTICLE)



## The effect of soil pH on a carbohydrate level of tomato fruits (*Lycopersicon esculentum* Mill.) from bobo and Sidera villages

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### Abstract

Soil pH has an effect not only on the growth and production of tomatoes but also has an influence on sugar metabolism. How the pH influences a production and the change of the sugar is still unknown. Therefore, this study aims to determine the effect of the soil pH on the carbohydrate content of tomatoes in Bobo and Sidera villages. The method used was quasi-experiment because the researchers did not randomly select tomatoes for the experimental group and the control group, but the researchers used tomato plants in the two villages that have the differences in the pH of the soil. The data obtained were analyzed using ANAVA assisted by XL STAT 2017 program. The results showed that the soil pH affected the carbohydrate content of tomato fruit found in Bobo and Sidera Villages. The pH of the soil in Sidera Village was lower than the pH found in the village of Bobo.

**Keywords:** Effect; Carbohydrate; Sugar; Soil pH; Tomato

### 1. Introduction

The degree of acidity or soil pH has an effect not only on the growth and production of tomatoes but also has an influence on sugar metabolism [1], [2]. This is because pH is very instrumental in the transport of ions used in the decomposition and preparation of sugar molecules [3], [4]. Various efforts to increase tomato fruit production have been carried out both through extensification and intensification. Particularly with intensification, one of the things that needs to be promoted is the effort to plant tomatoes at appropriate soil pH. The concentration of hydrogen ions (pH) is an important property because it affects the growth of plant roots and microorganisms [5], [6]. Root growth is generally preferred in some acid soils, at pH values between 5,5 and 6,5 [7]. The people of Central Sulawesi have unique consumption habits, for example the people always use tomatoes in every food making in the form of sambal and chili sauce always accompany food in the people of Central Sulawesi. Thus the people of Central Sulawesi are very different from the people in other provinces in the use of tomatoes. During this time people often eat tomatoes as vegetables, spices and others without knowing the carbohydrate content contained in them. This happens because public knowledge about carbohydrate content is still lacking due to the lack of research on macro nutrient content such as carbohydrates, fats, proteins and others.

This study was conducted to determine carbohydrate levels with indicators in the form of glucose, fructose, and starch which are a group of carbohydrate monosaccharides and polysaccharides in tomatoes whose sources are directly taken from Bobo and Sidera Villages, Sigi Regency whose unknown carbohydrate levels are glucose, fructose, and starch. Tomatoes from the two villages are thought to contain carbohydrates, especially glucose, fructose, and starch because they come from areas with different altitudes above sea level and have different fruit sizes.

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## 2. Field-Site Description

Sigi is one of the agricultural areas in Central Sulawesi which has a topography of 20% of the highlands and 80% of the lowlands. Bobo Village is located in the highlands area while Sidera Village in the lowlands where the sun's irradiation is definitely different so that the heat received by the soil is not the same so that it is suspected to affect the soil's pH.

Based on the Central Statistics Agency of Sigi Regency (2020), the results of GPS measurements in each village office in the subdistrict capital city in 2016, the height of the area above sea level is Bobo Village, Palolo Subdistrict, at an altitude of 720 meters above sea level, while Sidera Village, Sigi Biromaru District is located at altitude of 87 meters above sea level. So it is suspected that the two regions have different soil pH and no data has been reported on soil pH from the two villages so far.

## 3. Methods

This research was conducted using a quasi-experimental method because researchers did not randomly select tomatoes for the experimental group and the control group, but researchers used tomato plants in two villages namely Bobo Village and Sidera Village to be compared based on differences in soil pH owned it is different from the two villages.

Research implementation in the field is an activity of measuring the level of acidity (pH) of the soil and sampling conducted in Bobo Village and Sidera Village and research implementation in the laboratory is an activity to analyze carbohydrate content, namely glucose, fructose which is a group of carbohydrate monosaccharides and starch which is a group of polysaccharides carried out in the Biology Laboratory of FKIP, Tadulako University.

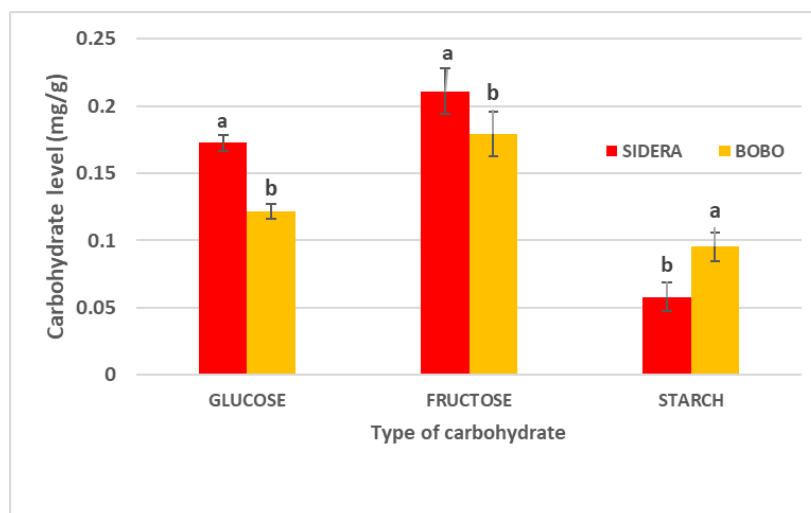
The data that has been collected will then be analyzed with the variance analysis technique (ANOVA) using the XL STAT 2017 application.

## 4. Results and Discussion

Measurement of Soil pH in Bobo was different from Sidera Village. Also, measurement of carbohydrate contents of both the villages differ from each other's. The results were presented in Table 1 and Figure 1.

**Table 1** Soil pH in Bobo and Sidera Village

Village	The degree of acidity (pH)
Bobo	6.27
Sidera	4.72



**Figure 1** Glucose, fructose and starch levels from the two sites show a significant difference

The Figure 1 showed that the glucose level of tomatoes grown in Sidera Village in mature fruit was 0.172 mg/g, while the glucose level in tomato in Bobo Village was 0.122 mg/g in mature fruit. Glucose content in ripe fruit in Sidera is higher compared to ripe fruit in Bobo Village. Thus, it can be said that there are differences in glucose levels in ripe fruits in Sidera and Bobo. Then, the fructose content of tomatoes grown in the village of Sidera in ripe fruit is 0.211 mg/g. While the fructose content of tomatoes in Bobo Village in ripe fruit is 0.179 mg/g. As such, the fructose content in ripe fruit in Sidera has more fructose content than ripe fruit in Bobo. Meanwhile, tomatoes from Sidera Village have starch levels in ripe fruits of 0.058 mg/g. While the starch content of tomatoes in the village of Bobo in ripe fruit is 0.095 mg/g. The data can be seen that the starch content in ripe fruit in Sidera is less than the ripe fruit in Bobo.

#### **4.1. Soil pH Affects Tomato Glucose and Fructose Levels**

The result in Sidera Village which has a lower soil pH compared to Bobo which has a higher effect on the process of glucose formation needed for the growth of tomato plants. Then, based on observations of glucose levels obtained that ripe tomatoes in Sidera have higher glucose and fructose which are monosaccharides group levels than in Bobo.

Low soil pH in Sidera causes only a small amount of glucose synthesis, which is probably caused by the absorption of nutrients needed to synthesize glucose and fructose, that is phosphorus is not sufficient, so glucose and fructose levels are high. Meanwhile, in Bobo Village which has a higher soil pH compared to the lower Sidera. It has an effect on the process of glucose and fructose formation needed for the growth of tomato plants. Based on research results obtained that the ripe tomatoes in Bobo have lower glucose and fructose levels than in Sidera. This is caused by the occurrence of glucose and fructose synthesis going well. Because the absorption of nutrients needed to synthesize glucose and fructose are sufficient phosphorus, so glucose and fructose levels are lower than in Sidera.

The results are supported by studies reported that the element phosphorus is easily absorbed in pH 5.0 - 8.5 [8], [9]. Furthermore other workers suggested that if plants lack phosphorus, the results of photosynthesis in the form of glucose cannot be synthesized to produce sucrose and circulated to plant parts via phloem [10], [11].

#### **4.2. Soil pH Affects Tomato Starch Levels**

The observation results in Sidera Village which has a lower soil pH compared to Bobo which has a higher effect on the process of forming starch needed for tomato plant growth. Based on observations of starch which are polysaccharides group levels obtained in ripe tomatoes in Sidera have less starch levels than in Bobo.

The results showed that less starch formed in Sidera ripe fruit than Bobo was due to the fact that glucose was not converted to sucrose to be distributed throughout the plant body or to starch. Because starch is the result of synthesis from glucose. In the process of photosynthesis, glucose is produced, then the glucose is converted into starch. In glucose and starch there is chemical energy. This energy is none other than the light energy of the sun captured during the process of photosynthesis. In this starch plants can be converted again into glucose. Glucose is used in the process of plant growth in the form of sucrose. If excess, starch is stored in a special part by plants. To convert starch into glucose or maltose, the enzyme amylase is needed [12]–[14].

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### **5. Conclusion**

Soil pH affects the carbohydrate content of tomatoes found in Bobo and Sidera Villages. The amount of pH in Sidera Village was lower than the pH found in Bobo Villages. The differences in soil pH, the carbohydrate content (glucose and fructose) in tomatoes in Sidera Village is higher than in Bobo. Whereas the carbohydrate (starch) content in tomatoes in Sidera Village is lower than in Bobo.

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### **Compliance with ethical standards**

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#### *Disclosure of conflict of interest*

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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