Journal of Biological Science and Education
~JBSE~
Website: http://usnsj.co.id/index.php/biology
Email: biologi_jbse@usn.ac.id

Analysis of Amilum Containment in Tomat Leaves (*Solanum lycopersicum*) Based on The Sach Test

AUTHORS INFO

Arum Sanjayanti
Universitas Indraprasta PGRI
arumsanja08@gmail.com
+6282129212369

Nurul Lia Putri
Universitas Indraprasta PGRI
liaputrinurul@gmail.com
+6285171101602

Khumairoh Adawiyah
Universitas Indraprasta PGRI
khumairohadawiyah24@gmail.com
+6285156331613

Bella Vista Rammanda Putri
Universitas Indraprasta PGRI
bellavista1311@gmail.com
+6282123211175

ARTICLE INFO

E-ISSN: 2721-0804
P-ISSN: 2723-6838
Vol. 6, No. 1, June 2024
URL: http://usnsj.com/index.php/biology

Suggestion for the Citation and Bibliography
Citation in Text:
Sanjayati *et al*. (2024)
Bibliography:
Sanjayati, A., Putri, N.L., Adawiyah, K., & Putri, B.V.R. (2024). Analisis of Amilum Containment in Tomat Leaves (*Solanum lycopersicum*) Based on The Sach Test. *Journal of Biological Science and Education, 6*(1), 11-16.

Abstract

Photosynthesis is the process of forming organic substances H2O and CO2 into complex organic compounds that require light. Photosynthesis can only occur in plants that have chlorophyll, a pigment that functions as a catcher of sunlight energy which will later be converted into starch. Starch, as a complex carbohydrate resulting from photosynthesis, plays a vital role in various important physiological processes in leaves. The aim of this research was to determine the starch content in tomato leaves (Solanum lycopersicum). The qualitative descriptive method was carried out by referring to the Sach method by measuring the starch content of leaves using aluminum foil and betadine (iodine) on tomato leaf samples. The research results showed that there was starch in tomato leaves that were not covered with aluminum foil after being dripped with iodine solution. This is evidenced by the change in leaf color to blackish blue on the surface of the leaf. Meanwhile, on tomato leaves that are covered with aluminum foil, the color of the leaves turns pale and there are only a few blue-black spots, this shows that leaves that are not directly exposed to the sun and do not undergo normal photosynthesis have little starch content in them.

Keywords: Amylum, S*olanum lycopersicum*, Sach Test

A. Introduction

Photosynthesis comes from the word photon which means light and synthesis which means preparation. So photosynthesis is the process of preparation of organic substances H_2O and CO_2 into complex organic compounds that require light. Photosynthesis can only occur in plants that have chlorophyll, a pigment that functions as a catcher of sunlight energy (Kimbal, 2002). With photosynthesis, green plants can make their own food. Therefore, green plants are a source of food for other living things including humans. Photosynthesis can only occur in plants that have chlorophyll, which is a pigment that functions as a catcher of sunlight energy (Kimbal, 2002). In simple terms, the overall chemical process in photosynthesis is as follows:

$$6CO_2 + 12H_2O + \text{light energy} \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$$

In photosynthesis, with the help of sunlight, carbon dioxide and water are converted into sugar/amylum and takes place in the stroma. Inside the organelle, pigment clusters that absorb sunlight energy use that energy to synthesize glucose from carbon dioxide and water. As a by-product of photosynthesis, oxygen is released. Photosynthesis occurs in chloroplasts with the help of photons of sunlight energy and takes place in two stages of reaction, namely the light reaction and the dark reaction, as for the experiment that proves photosynthesis is the Sach Experiment, with leaves closed and open, photosynthesis produces carbohydrates (Maniam & Yusa, 2014).

The Sach test, same known as the Iodine test, aims to prove the presence of amylum in tomato leaves. Amylum is a carbohydrate produced from the process of photosynthesis, where sunlight energy is converted into chemical energy in the form of sugar. By performing the Sach test on tomato (*Solanum lycopersicum*) leaves, we can directly observe evidence that photosynthesis produces amylum in tomato leaves (Wicaksono & Mursidawati, 2020). Amylum, a photosynthesized complex carbohydrate, plays a vital role in many important physiological processes in tomato leaves. Amylum acts as the main source of energy for leaves and all parts of the plant, supporting activities such as growth, respiration, reproduction, and maintenance of cell structure. In addition, amylum acts as an important food reserve, supporting energy needs when photosynthesis is not optimal. Its ability to bind water helps tomatoes maintain water balance within leaves and cells, preventing dehydration in dry seasons (Lytovchenko, et al., 2011). From the results of these preliminary studies, it is necessary to conduct further research on amylum activity in tomato (*Solanum lycopersicum*) leaves exposed to direct sunlight and leaves that are blocked from the photosynthesis process by covering the leaves with aluminim foil to know the characteristics of amylum in tomato plants.

B. Literature Review

Photosynthesis is an important process in plants that plays a role in converting sunlight energy into chemical energy stored in organic compounds. Plants need sunlight as an energy source to carry out two stages of reactions in photosynthesis. The first stage is the light reaction or called light-dependent reaction (LDR) which occurs in the thylakoid, while the second stage is the Calvin cycle or called light-independent reaction (LIR) which takes place in the stroma (Yustiningsih, 2019). Tomatoes are annuals that can reach 2 meters in height. The tomato stem is downy and has many branches. Tomato leaves are bright green and ovoid in shape. The flowers are bright yellow and have a flower crown consisting of five petals. The fruit is round, red in color, and has a sweet and sour taste (Suwarno, 2017).

According to Tugiono (in Gultom, 2018) tomato plants are classified as follows: Kingdom: Plantae, Subkingdom: Tracheobionta, Super Division: Spermatophyta, Division: Magnoliophyta, Class: Magnoliopsida, Sub Class: Asteridae, Order: Solanales, Family: Solanaceae, Genus: Solanum, Species: Solanum lycopersicum. According to the book Plant Anatomy (Lakitan, 2018), leaves are thin and wide plant organs, generally green in color, and have a complex structure. Leaves are composed of epidermis, mesophyll, and transport tissue. Leaves function for photosynthesis, respiration, transpiration, water storage, and photosynthesis. Amylum, also known as starch, is a type of polysaccharide carbohydrate produced through the process of photosynthesis in plants that is stored in several plant organs, such as roots, stems, and seeds as food reserves (Kumalawati et al., 2018). Amylum is an excess carbohydrate stored by plants as a food reserve that has a tasteless white color and is in the form of a soft amorphous powder (Sakinah & Kurniawansyah, 2018).

C. Methodology

1. Research Design

The test research to determine the amylum content was carried out using samples in the form of Tomato (*Solanum lycopersicum*) leaves which were carried out using descriptive methods. Descriptive methods are used in order to describe a series of data descriptions related to the research topic (Sarjani, et al., 2022). The descriptive method was carried out by referring to the Sach method by measuring the starch content in leaves that used tin foil (aluminum foil) and those that were freely exposed with betadine (Iodine). Sampling for leaves covered with aluminum was carried out the day before the practicum was carried out, then observations were made on tomato leaves covered with aluminum and those not covered with aluminum (open).

The procedure for testing amylum content was carried out with the Sach test method where in the experiment using fresh leaves wrapped in tin foil and the others were not covered (Figure 1.) Then the leaves were boiled, put into alcohol and dripped with iodine. In this Sach test aims to test whether without light, non-photosynthesizing leaves can produce amylum.

(a) (b)

Figure 1. (a) open tomato leaves; (b) closed tomato leaves.

2. Instruments

One of the plants that can be used as an object in the Sach amylum test on leaves is the leaves of the Tomato plant (*Solanum lycopersicum*). The materials used in this study include samples of tomato leaves (covered with aluminum, and those that are open), aluminum foil, 70% alcohol, betadine, and distilled water solution. The tools used consisted of a bunsen, three legs, tweezers, 250 ml and 500 ml beakers. The choice of research site is the Biology Laboratory of Indraprasta PGRI University Jakarta.

This study can be briefly described as follows. Test procedure: (1) The leaves were kept away from sunlight by wrapping them with aluminum foil the day before. (2) Furthermore, the leaves that have been wrapped are left for 1 day. (3) After 1 day, the tomato leaf samples taken were cooked using a glass jar. (4) After the leaves wilt, the leaves are moved in a container. (6) Then the washed leaves were put into a glass jar containing 70% alcohol, and boiled for 25 minutes. (7) The leaves were transferred to a clean container, given a few drops of betadine on the surface of the leaves, and after waiting for a while, observed the color changes that appeared as an indicator of the presence of amylum content in tomato leaves.

3. Technique of Data Analysis

At the time of the research, the data analysis technique used was a qualitative descriptive analysis model, where the model was included in the type of qualitative research which then explained the results of the research descriptively. Qualitative research methods emphasize the aspect of in-depth understanding of a problem or problem rather than seeing problems to be generalized. Descriptive research is a form of research aimed at describing existing phenomena, both natural and man-made phenomena. The phenomenon can be in the form, activity, characteristics, changes, relationships, similarities, and differences between one phenomenon and another (Rusandi & Rusli, 2022). In this case, it explains the amylum content in tomato (*Solanum lycopersicum*) leaves that have been observed descriptively.

D. Findings and Discussion

1. *Findings*

Identification of amylum was carried out using the Sach test method. From the experimental results in Table 1, it is known that starch is contained in tomato (*Solanum lycopersicum*) leaves with the treatment covered with aluminum foil or not covered with aluminum.

Table 1. Amylum Content Testing Results.

NO	Tomato (Solanum lycopersicum) Leaves Under Treatment	Amylum Ingredients	
		Positif Amilum	Negatif Amilum
1	Leaves covered with aluminum foil	✓	-
2	Leaves not covered with aluminum foil	✓	-

The results of amylum testing on tomato leaves (*Solanm lycopersicum*) with two different treatments used as research samples show that the research samples used contain amylum. The only difference is the amount of amylum contained in the tomato leaves themselves. In tomato leaves with treatment covered with aluminum foil (Figure 2) there is only a little amylum. While in tomato leaves with treatment not covered with aluminum foil (Figure 3) the amylum content is more abundant. It can be seen by the color changes that occur in leaves that are not covered with aluminum foil, where the color of the leaves turns darker on the entire surface of the leaves after being given an Iodine solution. The parts of the leaves that are exposed to sunlight from samples that are not wrapped in aluminum foil mean that these parts contain starch. This is consistent with other studies that leaves covered with aluminum foil do not produce starch and are therefore less colorful (Sarjani et al., 2022).

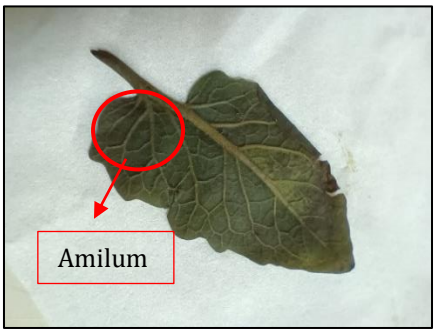

Figure 2. Leaves covered with aluminum foil

Figure 3: Leaves not covered with aluminum foil

2. *Discussion*

This study revealed that both samples were tested for their content, namely tomato leaves covered with aluminium foil and tomato leaves that were not covered with aluminium foil. Both leaves contained starch, as a dark green color change was seen in both samples when betadine solution was dripped. Both leaves contain starch, but the starch content in them is different, with tomato leaves that are not covered with aluminium foil having a higher starch content. Tomato leaves covered with aluminium foil have a lower starch content. This is due to different color variations. The color of the uncovered leaves turns bluish or darker, on the other hand the color for the covered leaves transforms into pale or yellowish green with a few bluish spots. The experimental results are in line with the statement, namely that Iodine solution can be used to detect starch and glucose content. In other words, this solution will react if there is starch content in an object.

Chemical identification of amylum content was carried out by conducting the Sach test on tomato leaves with different treatments, where color changes occurred on both leaves used in the study. Based on the results of the experiment, after being tested with Iodine there was a color change, where the color change occurred on both leaves with different treatments in every minute, on tomato leaves covered with aluminium foil the color change occurred during the first 40 minutes after which there was no significant color change (graph 1) and on tomato leaves that were not covered with aluminium foil the color change occurred in the 20th and 40th minutes (graph 2). Testing amylum with Iodine based on the addition of Iodine on the leaf surface causes the formation of a specific colored adsorption complex (Genting, 2024)

After being tested with Iodine, a color change occurs where the starch that binds to Iodine will produce a blue color. This property can be used to analyze the presence of starch. This is due to the molecular structure of Iodine and the formation of blue color. From experiments, it is

found that starch will reflect blue color when it is a glucose polymer greater than twenty, for example amylose molecules. If the polymer is less than twenty such as amylopectin, the red color will be produced. While dextrin with polymers 6,7 and 8 forms a brown color. Polymers smaller than five do not give color with Iodine (Choirunnisa & Boedijono, 2017).

The experiment is in accordance with the opinion of Fessenden (1986) which states that the shape of this helical chain causes starch to form complexes with Iodine molecules that can enter into its spirals, causing a dark blue color to the complex (Fitri & Fitriana, 2020) with the reaction:

$$3I_2 + 6\ NaOH \rightarrow 5\ NaI + NaIO_3 + 3\ H_2O$$

Basically, amylum is obtained through the process of photosynthesis. The process of photosynthesis has several factors for the process to occur. Based on the chemical equation related to amylum produced in leaves, it can be seen that in the process of converting CO2 and H2O, sufficient sunlight is needed. In a plant, the distribution process of a substance, such as in photosynthesis that distributes amylum, depends on the pressure of sunlight that affects chlorophyll, so that the distribution of substances in the closed and open parts of the leaf is also not the same because chlorophyll in the leaves with different treatments also gets different light (Zuraida et al., 2015)

Sunlight plays a role in assisting the electron transfer process. In essence, this process includes several processes: the light-induced electron transfer process and the second is the Calvin-Benson (CB) cycle in which carbon dioxide will be converted into carbohydrates in the chloroplast stroma (Sarjani, et al., 2022). The electron transfer reaction is assisted by two kinds of pigments contained in the thylakoid membrane. These two membranes have different light absorption where electrons will be transferred from feredoxin to Fd-NADP reductase which will function to reduce NADP + and end up becoming NADH and H +. From this process, protons will be produced that lead to the production of ATP which will react together with NADPH, which together will trigger the assimilation of CO2 for the Calvin cycle. Starting from the light cycle, the next stage is the dark cycle. In this cycle, ATP and NADPH that were previously produced are used in order to bind CO2 which aims to form ribose which will later become glucose (Suryati et al., 2016).

In line with the purpose of the research to observe the starch content of the leaves, it is necessary to distinguish the parts of the leaves that are observed. Chlorophyll contained in the open tomato leaves is able to absorb sunlight so that the photosynthesis process can occur and can distribute amylum, therefore, when the Amylum Test is carried out the open treated leaves are able to show a clear blue-black color indicating the presence of amylum. Meanwhile, chlorophyll in the aluminium foil-covered tomato leaves does not get light so that the chlorophyll does not photosynthesize and is unable to distribute amylum, therefore when the Amylum Test is carried out on the closed leaves, there is no significant color change, which is still pale yellow and there are few spots of blue-black color. This statement is supported by research which states that sunlight greatly affects the photosynthesis process. From the photosynthesis process described, it can be seen that leaves do not produce starch if they do not photosynthesize. This is because starch is glucose from photosynthesis that is stored as energy storage.

E. Conclusion

Analysis of the results of the study using the Sach Test to determine the amylum content in tomato leaves (*Solanum lycopersicum*) shows that samples that do not have a layer of aluminium foil on top have a dark green leaf color or darker or concentrated that the sample contains amylum produced by the photosynthesis process before the experiment is carried out with Iodine. The color of the leaves that have a layer of aluminium foil on it will transform into a paler green color when given a betadine solution. This experiment is seen how many changes occur in tomato leaves (*Solanum lycopersicum*) with a count of time. Based on the results and discussion in the table and graph above, the results of this experiment show that there is no amylum or starch content in the leaves. Thus, causing a lack of amylum because the leaves do not undergo photosynthesis due to lack of sunlight due to being covered with aluminium foil.

F. References

Choirunnisa, U., Eff, A. R., & Boedijono, E. P. (2017). Karakteristik Amilum Biji Durian (Durio Zibethinus L.) Dan Uji Aktivitas Antioksidan Secara In-Vitro. *Universitas Esa Unggul*, 1-8.

Fitri, A. S., & Fitriana, Y. A. (2020). Analisis Senyawa Kimia pada Karbohidrat. *SAINTEKS*, 45-52

Ginting, K. B. (2024). *Pengaruh Massa Bioadsorben Dari Daun Nanas (Ananas Comucus (L.) Merr) Pada Proses Pemurnian CPO (Crude Palm Oil)* (Doctoral dissertation, UIN Ar-Raniry Fakultas Sains dan Teknologi).

Gultom, A. (2018). Budidaya Tanaman Sayur. Medan: USU Press.

Kimbal, J. W. (2002). *Fisiologi Tumbuhan.* Jakarta: Erlangga.

Kumalawati, H., Izzati, M., & Suedy, S. W. A. (2018). Bentuk, Tipe dan Ukuran Amilum Umbi Gadung, Gembili, Uwi Ungu, Porang dan Rimpang Ganyong. Buletin Anatomi dan Fisiologi, 3(1), 56-61.

Lakitan, Benjamin. (2018). Anatomi Tumbuhan. Jakarta : Rajawali Pres

Lytovchenko, A., Eickmeier, I., Pons, C., Osorio, S., Szecowka, M., Lehmberg, K., . . . Fernie, A. R. (2011). Tomato Fruit Photosynthesis Is Seemingly Unimportant in Primary Metabolism and Ripening But Plays a Considerable Role in Seed Development. *Plant Physiology*, 1650-1663.

Maniam, & Yusa. (2014). *Advanced Learning Biology 1A for Grade X Senior High School.* Bandung: Grafindo.

Rusandi, & Rusli, M. (2022). Merancang Penelitian Kualitatif Dasar/Deskriptif dan Studi Kasus.

Sakinah, A. R., & Kurniawansyah, I. S. (2018). Isolasi, Karakterisasi Sifat Fisikokimia, dan Aplikasi Pati Jagung dalam Bidang Farmasetik [Isolation, Physicochemical Properties Characterization, and Application of Corn Starch in Pharmaceuticals]. Jurnal Farmaka, 16(2), 430-442.

Sarjani, T. M., Mahyuni, S. R., Muriza, A., Damayanti, D., Hasibuan, F. U., Nuzhula, L., . . . Yurida. (2022). Kadar Simpanan Amilum Daun Suruhan, Daun Kelor, Dan Daun Kitolod. *BIOMA: Jurnal Biologi dan Pembelajaran Biologi*, 172-183.

Suryati, E., Triana, H., Widiastuti, U., & Tenriuloh, A. (2016). Regenerasi Dan Perbanyakan Rumput Laut Kappaphycus Alvarezii Hasil Transformasi Gen Superoksida Dismutase (MaSOD). *Jurnal Riset Akuakultur*, 321-330.

Suwarno, H. (2017). Budidaya Tomat. Jakarta: Pustaka Baru.

Wicaksono, A., & Mursidawati, S. (2020). Lugol's iodine test on Rafflesia patma–Tetrastigma leucostaphylum intersection tissue for preliminary starch visualization. *Nusantara Bioscience*, *12*(2).

Yustiningsih, M. (2019). Intensitas cahaya dan efisiensi fotosintesis pada tanaman naungan dan tanaman terpapar cahaya langsung. Jurnal BIOEDU, 4(2).

Zuraida, N. U., Yuliani, & Ratnasari, E. (2015). Kelayakan Teoritis Lembar Kegiatan Siswa Uji Amilum Hasil Fotosintesis Untuk Melatihkan Keterampilan Proses TerintegrasI. *BIOEDU*, 1023-1028.