Sainmatika: Jurnal Ilmiah Matematika dan Ilmu Pengetahuan Alam
Volume 20 No. 2, December 2023 DOI 10.31851/sainmatika.v20i2.11322
https://jurnal.univpgri-palembang.ac.id/index.php/sainmatika

Effect of Tomato Juice Volume on Coagulation Time and Latex Weight

Dewi Putri Yuniarti[1],Surya Hatina[1*], Nidya Afriyani[1]
*e-mail: surya@unitaspalembang.ac.id

[1]*Chemical Engineering Program, Faculty of Engineering*
Universitas Tamansiswa Palembang, Indonesia

ABSTRACT

Natural latex clumping takes longer than using chemicals. Another alternative is needed to coagulate the latex by adding acid from natural ingredients. Tomatoes (*Lycopersicum esculentum* Mill) have 29.32 mg of ascorbic acid and 0.54 g of citric acid every 100 grams, they have the potential to be used as a natural latex coagulator. The research method add tomato juice to fresh latex to break down the emulsion and form rubber lumps. After mixing, the weight of the latex is weighed. The constant variables are the latex volume of 10 ml, and the tomato juice volume of 5,10,20,30,40,50,60,70,80,90 and 100 ml respectively. The higher the volume of tomato juice, the faster it will clot. The best volume of tomato juice is 100 ml with a clumping time of 52 minutes. Increasing the volume of tomato juice increased the weight of latex to 13.1 grams and reduced the pH of latex to 4.9. Giving tomato juice every 5 ml accelerated clumping up to 360 minutes (6 hours) compared without tomato juice.

Keywords: rubber, latex, tomato, latex clumping.

INTRODUCTION

Latex is a tapping product from rubber trees in the form of a thick, milky white liquid by cutting it in circles along the bark of the tree. The latex content consists of rubber, resin, protein, carbohydrates and water with varying percentages based on the type of plant and quality of the rubber tree (Ali et al., 2020). Fresh latex from rubber trees is a colloid from an emulsion system. The rubber becomes dispersed particles and the dispersion is in the form of a liquid called serum latex using a protein and lipid emugator (M. Sirait, 2011).

Coagulation or clumping of latex by adding acid compounds. Some acid chemicals are formic acid, liquid smoke, TSP, acetic acid and sulfuric acid (Selpiana et al., 2015). But this will damage nature if used continuously. Therefore, an alternative latex coagulant that is environmentally friendly and easily renewable is needed. Researchers are now conducting trials by adding natural coagulants from plants that have a low pH or acid content in fruit or other plant parts.

There are 2 types of coagulation, namely coagulation with microorganisms and coagulation with acidic substances. The acids used include formic acid, acetic acid, liquid smoke, TSP, and sulfuric acid (Selpiana et al., 2015). The process of rubber clumping in latex can also occur naturally due to microbial activity. Latex carbohydrates and proteins become energy sources for microbial growth and are converted into etheric fatty acids (formic acid, acetic and propionic acids). The higher the acid concentration, the pH of the latex will decrease and once the isoelectric point is reached the rubber will coagulate (Hatina & Febriana, 2019).

The acid is added at once and the pH of the coagulation is around the isoelectric point of the latex, namely pH 4.4 – 5.3 so that perfect coagulation is obtained and the resulting natural rubber has good properties and quality (Safitri, 2010).

The previous research, Selpiana (2015) uses cermai fruit juice as a natural coagulant in the latex coagulation process. Based on the research results, optimum results were obtained, namely by using cermai fruit juice with extract volume composition parameters of 10% and a clumping time of 24 hours. Another thing, the use of natural coagulants from starfruit extract was previously researched by Mukhlisin & Akhyarnis (2019). In the research, starfruit extract had an effect on coagulation time, wet rubber mass and dry rubber percentage, but had no effect on pH and dry rubber mass. The use of rambutan fruit extract has also been carried out by Farida Ali, et al, 2019 (Farida et al., 2009). The results of the research were carried out by freezing latex with extracts of rambutans with seeds and those without seeds.

"Tomato" from the Nauhat language and is phylogenetically close to potatoes (S.Kusumaningtyas, R A, 2016) . Tomato (*Lycopersicum Esculentum Mill*) contains ascorbic acid of around 29.32 mg/100 g and citric acid of around 0.54 g/ 100 g (Borba et al., 2021). Therefore, tomatoes can be used as an alternative material for latex coagulants because they are quite abundant and easy to obtain. This research aims to determine the effect of tomato juice as a latex coagulant on time clumping, pH and rubber weight.

MATERIAL AND METHOD

Tools

The tools used are a knife, juicer, measuring cup, pH meter, spatula, analytical scale and stopwatch.

Materials

The materials used are tomatoes, latex and clean water.

Method

The tomatoes used come from market waste, the rubber latex comes from rubber plants in Banyuasin Village, South Sumatra. The tomatoes were crushed using a juicer, strained, the tomato juice was used directly for research.

The stage for coagulating latex is to prepare a glass beaker for mixing. Put 10 ml of latex into each beaker, mix the tomato juice into the beaker with a volume of 5 ml, 10 ml, 20 ml, 30ml, 50 ml, 60 ml, 70 ml, 80 ml and 100 ml respectively. Record the time after the latex coagulates, note if there is any remaining solution, move the rubber in a container with the container positioned at the right slope. After clumping, weigh the latex.

Research Diagram

The flow diagram used in this research is as follows:

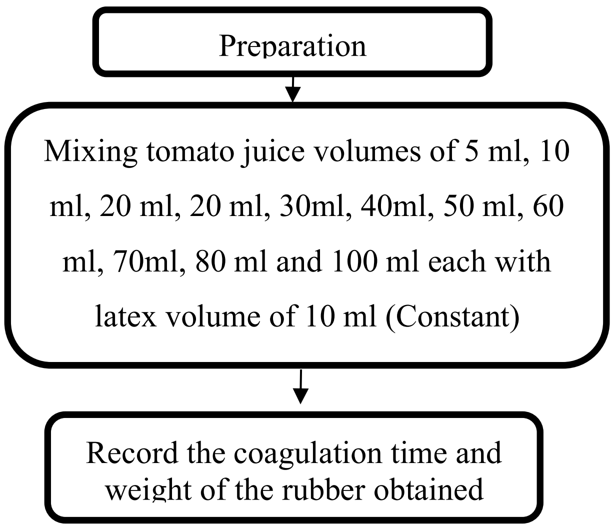

Figure 1. Research Flow Diagram

RESULT AND DISCUSSION

The results of the observations are described below:

1. Before the latex coagulation process, an initial test was carried out to determine the pH of tomato juice and rubber latex using a pH meter and obtained a latex pH value of 6.8 and a pH of tomato juice of 4.4. The tomato

p-ISSN 1829 586X
e-ISSN 2581-0170

juice used is tomatoes that are no longer suitable for consumption, the rubber latex used is fresh rubber latex.

2. Analysis of the Effect of Tomato Juice Volume on latex coagulation time

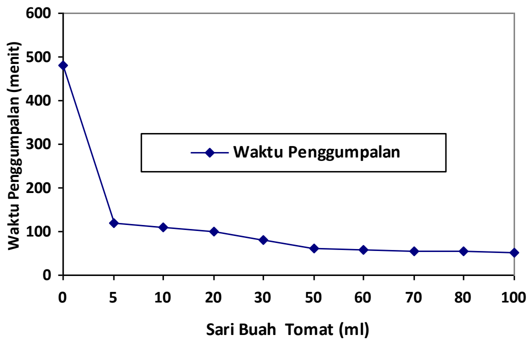

Figure 2. Effect of tomato juice volume on latex coagulation time

Figure 2 shows the procoagulation/coagulation time of latex naturally or without using tomato juice, namely 480 minutes or 8 hours. Latex without the addition of tomato juice requires quite a long clumping time because it is only influenced by the activity of bacteria, microorganisms or enzymes, which is usually found in many weather-affected environments or from equipment commonly used by rubber tappers. These acid-producing bacteria will reduce the pH of the latex to the isoelectric point. The large number of microorganisms will produce increasing amounts of acid. High temperatures make bacteria more active, causing their colloidal stability to be damaged by heat. This can result in a decrease in the pH of the latex to its isoelectic point. At the acidity level, a balance of electric charges or an isoelectic point can be reached on the surface of the rubber particles which lose their neutral charge, so that the latex formed produces an unpleasant odor due to the presence of volatile substances (Andriani et al., 2018).

Tomato juice contains citric acid. It is known that per 100 grams of tomatoes the citric acid content is 29.32 mg (Borba et al., 2021). Citric acid is needed to determine the clumping time of latex. The more citric acid used, the faster clumping will occur (V. A. A. Sirait et al., 2020). Therefore, this research varied the volume of tomato juice to find out how quickly the latex would coagulate. The greater the volume of tomato juice used, the faster the latex coagulation time and the heavier the rubber produced.

5 ml tomato juice was added to 10 ml latex (1: 2), coagulation time 120 minutes. There is a very significant time difference between the natural latex coagulation process or without using media, due to the occurrence of a decrease in electrical charge. The decrease in electrical charge due to a decrease in the pH of the latex is due to the citric acid content in tomato juice (Silvia et al., 2016). The next variable, 10 ml of tomato juice was added (1: 1), the coagulation time was 110 minutes, with a time difference of around 10 minutes from the previous variable. This is because the greater concentration of tomato juice causes the latex to reach the isoelectric point more quickly, which causes the latex to clot. Latex lumps, which are processed rubber, are formed naturally from the process of coagulating fresh latex liquid, usually placed in a bowl (Budiman, 2012). Adding 20 ml of coagulating material, the coagulation time is faster than adding a volume of 10 ml. The more coagulant there is, the more H+ ions will bond with OH- ions, causing the isoelectic point of the latex to be neutralized, becoming neutral and speeding up the latex clumping process (Nisa & Aminudin, 2019).

Research shows a rapid change in coagulation time due to the increasing contact area of the latex coagulant. This is due to the influence of the acidity level in tomato juice which causes latex clumping to occur. This colloid will combine and clump together to form a lump. These

p-ISSN 1829 586X
e-ISSN 2581-0170

large colloid clumps will freeze, this will also cause procoagulation (Rachmad Edison et al., 2016) .

3. Analysis of the effect of tomato juice volume on rubber weight

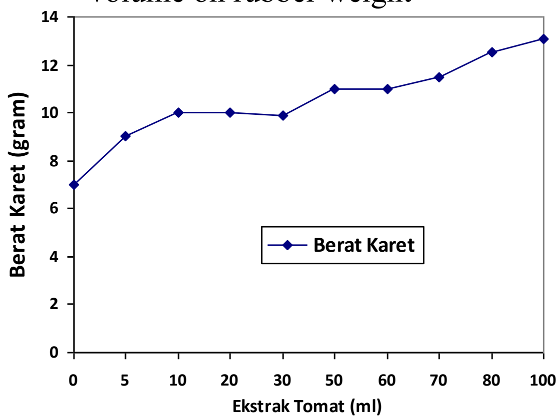

Figure 3. Effect of tomato juice volume on rubber weight.

Figure 3 shows the weight of rubber from the natural coagulation process and tomato juice which have different weight results. In the process of freezing 10 ml of natural latex or without adding tomato juice media, the resulting weight is 7 grams. Spontaneous clumping of latex which is influenced by microorganisms in the separation of other substances in the latex to produce acid, causing a foul odor. Clumping can also be caused by the appearance of anions resulting from decomposition in the latex in the form of fatty acids. Some of these anions react with calcium and magnesium ions in the latex to form insoluble substances, both of which can cause instability in the latex resulting in lumps (Andriani et al., 2018).

After adding 5 ml of tomato juice, the weight obtained was 9 grams or more than the weight of rubber without adding tomato juice. The added tomato juice is mixed with latex so that the weight of the rubber produced also increases. In this case the tomato juice is stable and as needed so that the relationship between water and acid increases. Therefore, particles that experience solubility will more easily combine to form clumps.

Conclusion, more tomato juice in 10 ml of latex, the heavier of rubber. Increasing the amount of acid used will accelerate the decrease in the value of the electrical charge on the latex molecules, resulting in a decrease in the pH of the latex. Latex proteins that lose their charge experience a change in protein shape, due to the acid in tomato juice, the protein blanket that is used to protect the proteins of latex particles will collide, resulting in clumping. The condition of the tomato juice is stable so that there is an increase in the interaction of acid and water. Therefore, it will make it easier to mix the dissolved particles to form particles of larger size thereby breaking the latex emulsion and increasing the weight of the rubber (Ali et al., 2016). The best research results obtained were the addition of 100 ml of tomato juice to 10 ml of latex which produced a rubber weight of 13.1 grams and left a mixture solution of 94.8 ml in the coagulation process.

4. Analysis of the effect of tomato juice volume on rubber pH

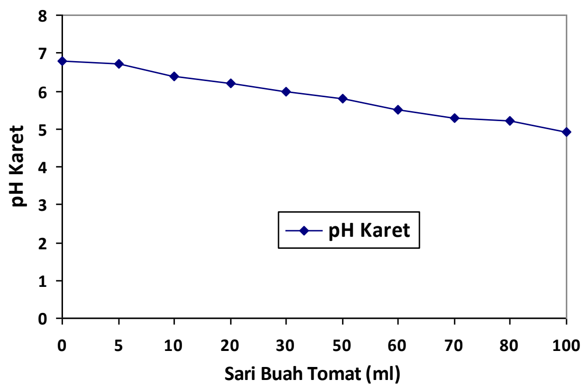

Figure 4. Effect of tomato juice volume on rubber pH

Figure 4 shows that the more volume of coagulant, the pH of rubber decreases (Purnomo et al., 2015). this study proves that the more volume of coagulant addes to the latex, the easier it is for H+ ions to combine with OH^- ions in the latex and neutralize the isoelectric point of the latex and accelerate the coagulation of latex. If more volume of coagulant is added to the latex, the contact surface between the coagulant and latex will increase (Ali et al., 2016). As a result, the pH of the latex decreases and clumping occurs because many of the H+ ions of the latex coagulant bind with OH- ions. (Rachmad Edison et al., 2016).

Ascorbic acid and citric acid in tomatoes can reduce the pH of the latex to its isoelectric point and destabilize the negative charge in the latex, resulting in clumping (Laoli et al., 2013). This acidity level (pH = 4.4) results in a balance of electric or isoelectric charges on the surface of the rubber particles which lose their neutral charge, thus causing latex clumping (Valentina et al., 2020).

CONCLUSION

Tomatoes can be used as a natural ingredient to coagulate latex. The research results showed that adding more tomato juice would speed up the CLUMPING time. The maximum time was obtained when adding 100 ml of tomato juice with a clumping time of 52 minutes. Increasing the volume of tomato juice also increased the largest latex weight by 13.1 grams and reduced the lowest latex pH by 4.9. Giving 5 ml of tomato juice accelerated 360 minutes (6 hours) compared to without adding tomato juice.

REFERENCES

Ali, F., Astuti, W. N., & Chairani, N. (2020). Pengaruh Volume Koagulan, Waktu Kontak Dan Temperatur Pada Koagulasilateks Dari Kayu Karet Dan Kulit Kayu Karet. *Jurnal Teknik Kimia*, *21*(3), 25–33.

Ali, F., Euniwati, S., & O.Vinsensia. (2016). *Pengaruh Volume Koagulan, Waktu Kontak dan Temperatur Pada Koagulasi Lateks Dari Asam Gelugur*. *22*(2), 2015–2016.

Andriani, W., Puspitasari, S., Wydiantoro, A. N. Z., & Muslich, M. (2018). Evaluasi Jenis Bahan Penstabil Dan Koagulan Lateks Pada Sistem Reaksi Hidrogenasi Katalitik Lateks Karet Alam Skala Semi Pilot. *Jurnal Penelitian Karet*, *May 2018*, 89–100. https://doi.org/10.22302/ppk.jpk.v36i1.559

Borba, K. R., Aykas, D. P., Milani, M. I., Colnago, L. A., Ferreira, M. D., & Rodriguez-Saona, L. E. (2021). Portable near infrared spectroscopy as a tool for fresh tomato quality control analysis in the field. *Applied Sciences (Switzerland)*, *11*(7). https://doi.org/10.3390/app11073209

Budiman, H. (2012). *Budidaya karet unggul* (Pertama).

Farida, A., Merry, H., & Yulia. (2009). Penggunaan Ekstrak Buah Rambutan Sebagai Peenggumpal Lateks Pasca Panen (Studi Pengaruh Volume, Waktu dan pH Pecampuran). *Jurnal Teknik Kimia*, *16*(2), 20–27. https://doi.org/10.35449/teknika.v5i2.94

Hatina, S., & Febriana, I. (2019). Penggunaan Ekstrak Belimbing Wuluh Matang Sebagai Penggumpal Lateks Pasca Panen (Study Pengaruh Volume, Waktu Pencampuran, Temperatur dan pH). *TEKNIKA: Jurnal Teknik*, *5*(2), 169. https://doi.org/10.35449/teknika.v5i2.94

Laoli, S., S, I. M., & Ali, F. (2013). Pengaruh Asam Askorbat Dari Ekstrak Nanas Terhadap Koagulasi Lateks (Studi Pengaruh Volume dan Waktu Pencampuran). *Jurnal Teknik Kimia*, *19*(2), 49–58.

Mukhlisin, & Akhyarnis, F. (2019). Pengaruh Penggunaan Ekstrak Belimbing Wulu (Averrhoa bilimbi L.) Sebagai Penggumpal Getah Karet. *Jurnal Sains Agro*, *4*(2), 1–7. https://ojs.umb-bungo.ac.id/

Nisa, N. I. F., & Aminudin, A. (2019). Pengaruh Penambahan Dosis Koagulan Terhadap Parameter Kualitas Air dengan

Metode Jartest. *JRST (Jurnal Riset Sains Dan Teknologi)*, *3*(2), 61. https://doi.org/10.30595/jrst.v3i2.4500

Purnomo, L. J., Nuryati, N., & Fatimah, F. (2015). Pemanfaatan Buah Limpasu (Baccaurea lanceolata) Sebagai Pengental Lateks Alami. *Jurnal Teknologi Agro-Industri*, *1*(1), 24–32. https://doi.org/10.34128/jtai.v1i1.27

Rachmad Edison, dan, Pengajar Jurusan Budidaya Tanaman Perkebunan, S., & Negeri Lampung Jl, P. (2016). Pengaruh Dosis Serum Lateks terhadap Koagulasi Lateks (Hevea brasiliensis) (The Effect of Dose Latex Serum to Latex Coagulation [Hevea brasiliensis]). *Jurnal Agro Industri Perkebunan Jurnal AIP*, *4*(10), 703995.

S.Kusumaningtyas, R A, A. (2016). Identifikasi Kematangan Buah Tomat Berdasarkan Warna Menggunakan Jaringan Syaraf Tiruan (JST). *Jurnal Penelitian Pendidikan Guru Sekolah Dasar*, *6*(August), 128.

Safitri, K. (2010). Pengaruh Ekstrak Belimbing Wuluh (Averrhoa bilimbi L) sebagai Penggumpal Lateks terhadap Mutu Karet. In *Universitas Sumatera Utara*.

Selpiana, Ulfa, A., & Maryam, M. (2015). Pemanfaatan Sari Buah Ceremai (Phyllanthus Acidus) Sebagai Alternatif Koagulan Lateks. *Jurnal Teknik Kimia*, *21*(1), 30–38.

Silvia, R., Pemanfaatan, N. :, Jenis, B., Sebagai, B., Lateks, P., & Kimia, N. P. (2016). Pemanfaatan Berbagai Jenis Bahan Sebagai Penggumpal Lateks. *Elkawnie: Journal of Islamic Science and Technology*, *2*(1), 74–80. www.jurnal.ar-raniry.com/index.php/elkawnie

Sirait, M. (2011). Pengaruh Campuran Sari Jeruk Nipis Dan Asam Format Sebagai Bahan Penggumpal Lateks Terhadap Sifat Vukanisasi Karet. *Jurnal Penelitian Saintika*, *1*(20221), 36–44.

Sirait, V. A. A., Zulkifli, Z., Handayani, T. T., & Lande, M. L. (2020). Pengaruh Penambahan Asam Sitrat Terhadap Proses Non-Enzimatik Browning Jus Buah Pir Yali (Pyrus bretschneideri Rehd.). *Jurnal Penelitian Pertanian Terapan*, *18*(3), 186. https://doi.org/10.25181/jppt.v18i3.1505

Valentina, A., Agus, Y. H., & Herawati, M. M. (2020). Study of Pineapple Exocarp, Gadung Tuber and Liquid of Pulp Cocoa Fermentation As Latex Coagulants Toward Rubber Quality. *Agric*, *32*(1), 1–12. https://doi.org/10.24246/agric.2020.v32.i1.p1-12.