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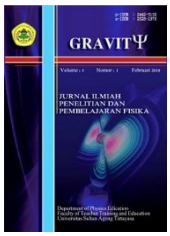

Determine of the nira water viscosity by using video based laboratory falling ball method with tracker software

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ABSTRACT

This study aims to determine the viscosity of nira water using a falling ball method based on a video based laboratory with tracker software. This type of research is experimental research with a quantitative approach. The viscosity of nira water is measured by varying the temperature, concentration and duration of fermentation. The temperature varied, namely 16^0C, 27^0C and 82^0C. The concentrations were varied by comparing the viscosity coefficient value of pure nira water, nira water added with coconut water and mineral water. And for the fermentation time of the nira water was varied for 7 days, 9 days and 11 days of fermentation. The nira water with varying temperature, concentration and fermentation time has different coefficient values for the nira water. The nira water given the highest temperature has the lowest viscosity coefficient value. And the nira water with the highest concentration has the highest viscosity coefficient value as well. And the longest fermented juice showed the lowest value of the viscosity coefficient of nira water. And from the results of my interviews with nira water farmers in the village regarding the good viscosity coefficient value of nira water, it can be taken from the value of viscosity coefficient of pure nira water, as researchers also examined in this research. Because researchers saw to harvest nira water directly from the tree for research on pure nira water.

Keywords: Concentration, fermentation, nira water, temperature, viscosity coefficient

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INTRODUCTION

Nowadays technology is growing. Food needs are also increasing. However, there are several types of plants that produce food and produce high quality sales values. So that it can increase the community's economy. In several villages in West Lombok Regency, namely Desa Kekait in particular. Kekait Village is one of 16 villages in Gunung Sari District, West Lombok Regency. Geographically, Kekait village is bordered by North Lombok Regency to the north, in the south it is Taman Sari village, to the east it is Guntur Macan village and to the west it borders Batu Layar District. Kekait Village is the largest village in Gunungsari District, namely 9.96 Km^2 (18.79%). Kekait village is one of the villages that is overgrown with palm trees. Most people use palm nira to be processed into palm sugar. Therefore the village of Kekait is known as the center for producing palm sugar in West Lombok district. Most of the people in Kekait Village rely on palm nira as an economic support by processing it into palm sugar (Hary Kurniawan, Ansar, Kurniawan Yuniarto, 2018). In the process of making palm sugar, knowing the viscous of the nira used as a

staple is very important. Fluid is particles that are easy to move and change shape without splitting the mass. The fluid resistance to deformation is very small so that the fluid can easily follow the shape of the space. Based on its form, fluid can be divided into two, namely: liquid fluid and gaseous fluid. To understand fluid flow you must know some basic properties of fluids. The basic properties of the fluid, namely; viscosity, density, specific gravity, pressure, temperature (Yohana et al., 2015).

Viscosity can be expressed as fluid flow resistance which is the friction between liquid molecules with one another. Fluid, both liquid and gaseous substances of different types have different levels of viscosity. Viscosity, is actually the friction force between the molecules that make up a fluid. So the molecules are 0 0 0 forming a fluid rubbing against each other when the fluid flows. In liquids, viscosity is due to the cohesion force (attractive forces between similar molecules). Whereas in gaseous substances, viscosity is caused by collisions between molecules. A type of liquid that flows easily can be said to have a low viscosity, and on the other hand, materials that are difficult to flow are said to have a high viscosity (Waluyo & Sabarman, 2019). This opinion is also supported by Soebyakto et al. (2016) and Yunita (2018) which states that viscosity is the nature of a liquid (fluid) due to the friction between the molecules of the substance liquid with a cohesion force on the liquid. It is this friction that blocks the flow of substances liquid. Viscosity determines the ease with which a molecule moves due to the friction between the layers of the material. Same with opinion of Mani & Rao (2017) that Viscosity is an important thermodynamic property of a fluid.

To produce the viscosity of the nira, an analysis is needed using the viscosity equation which requires the value of the time the ball falls as measured using the video-based laboratory-based falling ball method which is analyzed in the tracker software in this study. Software Tracker is a software used to analyze the motion of objects through the video so it can produce changes in the position parameter, parameter velocity, acceleration, kinetic energy, potential energy, and other parameters that are owned by objects that move. Tracker software can be used as a helper for analytical activities for research purposes (Irbah & Asrizal, 2019). The viscosity is a physical phenomenon that occurs whenever the adjacent layers of the same fluid are in relative motion, that is to say when it establishes a velocity gradient (Abollé et al., 2009). Viscosity is an important property in food materials. Factor of determines viscosity is temperature (Gómez-Díaz et al., 2009). And in research that was also conducted by (Raflesiana et al., 2019) said that tracker software makes it very easy to analyze experimental video results and video analysis errors using tracker software is relatively small. So that the researchers in this study chose to use the trcaker software to analyze the video results of the falling ball experiment on the nira water. Tracker is using for analysis of video to give some information about the position of marbles in time, and the modulus application help to simulate and modeling which it was representation with animation, table, data or graph (Eso et al., 2017).

Research measuring the viscosity of a fluid was carried out by (Khairunnisa, 2019) who examined the determination of water viscosity using a tracker-based damped oscillation method. In his research, he concluded that the factors that influence the difference in the results of the viscosity value from the experiment with the reference viscosity value are due to the difficulty in determining the center of mass of the object's motion because the motion of the object recorded in the video tracker is not so clear due to the fast-moving and sometimes rotating mass movement causing the tracking point. be slightly moved and other factors that influence due to the movement of the object that oscillates back and forth make the liquid medium unstable (turbulence) so that it affects the motion of the oscillation itself. And from research have been done, researchers choose use falling ball method with a video based laboratory and analysis using software tracker.

Therefore, researchers conducted this study

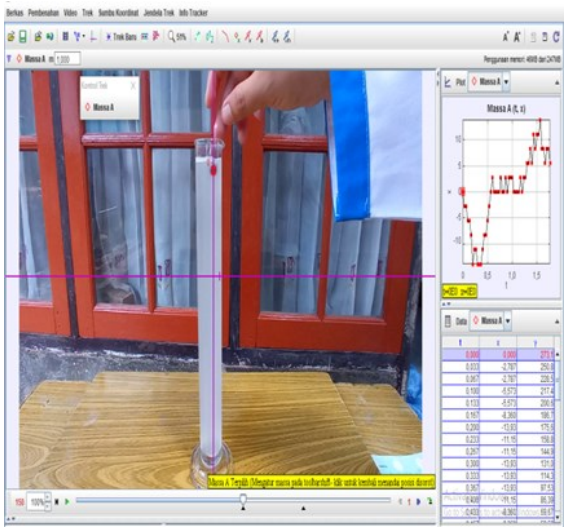
to help measure the consistency of nira water using a simple method and by utilizing technology that is increasingly developing today. In this study, researchers measured the viscosity (viscous) of nira water using a video-based laboratory-based falling ball method with tracker software.

RESEARCH METHODS

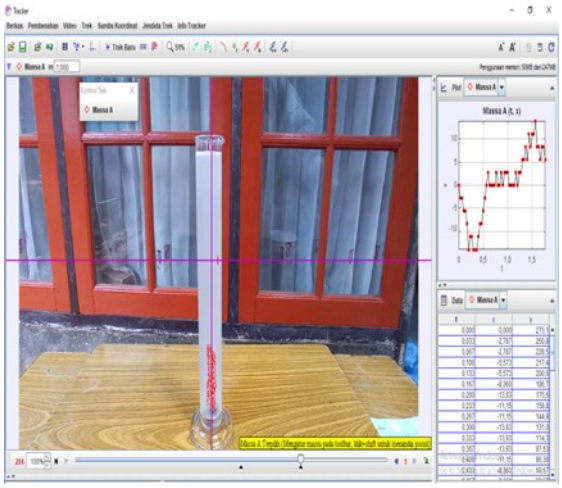
This research is a study using an experimental method with a quantitative approach. This research used a video-based laboratory-based method of a falling ball on the juice on a tracker software and analyzed on tracker software. Tools use are balls made of acrilic with mass 0,049 kg and diameter 0,00915 m, measuring glass 250 ml and computer was installed software tracker. And material using pure nira water, nira water + mineral water, nira water + coconut water. Nira water variation temperature and long time fermentation. VBL is a practicum activity in a laboratory form video analysis based educational software. One of the names of VBL based software is tracker. Tracker is a video analysis and modeling software built with a framework using Java. Features provided include tracking objects by position, speed and acceleration layers and graphics, special effects filters, multiple reference frames, calibration points, line profiles for spectrum analysis and interference patterns, as well as particle dynamics models (Yulkifli & Ramli, 2018). This Research was held at the Physics Laboratory of Mataram State Islamic University. This research was conducted by dropping the ball in the nira water recorded on video for analysis in the tracker software. The research procedure for measuring viscosity are : (1)Prepare research samples; (2) Measure the diameter of the ball with a caliper; (3) Prepare the tubes by inserting the respective sampleshas varied fermentation time, concentration and temperature; (4)Inserting the ball into each tube containing the sample research in turn; (5)hen record using a digital camera; (6)Then the file is transferred to the computer where the tracker software is installed; (7)After that the file is opened using tracker software, measurement the volume by dropping the ball is then rammed up obtained data on the time of falling the ball is valid; (8) After completing data retrieval, then take the data viscosity of each each sample then calculates the value of the viscosity coeficient with the viscosity coeficient equation.

Calculation of the viscosity of nira water is done using the equation (1):

$$\eta = \frac{2r^2(\rho_{ball} - \rho_{fluid})gt}{h_{tube}} \qquad (1)$$



(a)



(b)

Figure 1. data processing in the software tracker, start from the figure surface fluid (a) to figure (b) base of fluid

Where η is the viscosity coefficient with the SI unit for η is Ns / m = 1 Pa.s, for the cgs η unit is dyn.s / cm = 1 poise = 10- 1 Ns / m (Sanit, 2018). For the water viscosity coefficient at 20 C, it is 1.00 × 10-3 Ns / m2 (Tipler, 1998) (Khairunnisa, 2019). ρ is the density in kg / m . g is the gravity of the earth in units of m / s . t is the time the ball fell in seconds. And h is the height of the tube / measured glass in meters (m). Data processing with tracker showed by figure 1.

RESULTS AND DISCUSSION

According to Yusibani et al. (2017), viscosity is a property of a fluid which describes the resistance of the fluid when it flows. The greater the value of the viscosity coefficient, the greater the resistance of the fluid to flow.

In this study, the researchers chose to measure the viscosity of nira water using a falling method based on a video-based laboratory with tracker software. Tracker application to use to analyze the motion parameters of objects through video recordings of the experiment (Marliani et al., 2015). A similar opinion was also expressed by (Agustina Dwi Astuti et al., 2018)who mentioned that the tracker is software that has the ability to analyze. The researcher chose to use this method because it is simpler and younger, moreover, the researcher processed the video of the fall ball analysis in the tracker software. So that this research can be updated from previous research. Researchers who have conducted research on blood viscosity designed hardware using the falling ball viscometer small tube method were carried out by (Dewita & Harmadi, 2019). However, in this study there are deficiencies related to measuring samples by comparing several tools by measuring the time the ball falls with a stopwatch which results in human error. Research to determine viscosity has also been carried out by (Khairunnisa, 2019) who measured the viscosity of water using a tracker -based damped oscillation method. Tracker is used to analyze video through positioning against time, and presents graphs and uses the fit builder feature to determine the damping coefficient. As for the results of this study, it can be seen that the factors that influence the difference in the results of the viscosity value from the experiment with the reference viscosity value are due to the difficulty in determining the center of mass of the object's motion because the motion of the object recorded in the video tracker is not very clear due to the fastmoving and sometimes rotating mass movement. The tracking point is slightly moved and other factors that affect it due to the movement of the object that oscillates back and forth causing the liquid medium to be unstable (turbulence) so that it affects the oscillation motion itself. Viscosity research has also been conducted by (Rr. Sinta Kusuma Ninngrum & Moh. Toifur. 2014) who conducted a study to measure the viscosity of sugar solutions using the vessel connected viscosimeter method based on a video-based laboratory with tracker software. In this study, it needs to be improved so that the correction value is not too large, this is possible when the video data collection used is still unclear so that the tracking data is not optimal. The correction value can be determined by equation (2).

$$R = \frac{\Delta\eta}{\eta} \times 100\% \qquad (2)$$

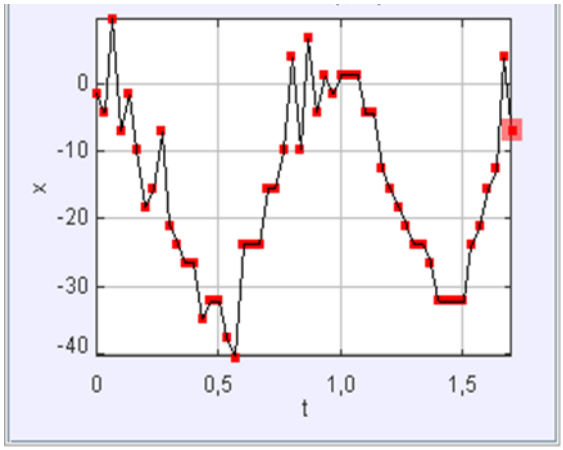
Where R is the percentage of the correction data and $\Delta\eta$ is the deviation of viscosity constant (Ns/m).

There are several factors that affect viscosity, one of which can have a major effect viscosity is temprature (Widiyatun et al., 2019)and according to (Parmin Lumbantoruan & Erislah,2016)factors that affect viscosity are temperature, solution concentration, molecular weight dissolved, and pressure. Temperature is inversely related to viscosity. If the temperature rises then the viscosity going down, and vice versa. So it can be concluded that temperature has an effect on viscosity. The same opinion is also proven by (Damayanti et al., 2018)who say that There are several factors that influence the viscosity of the fluid, one of which is

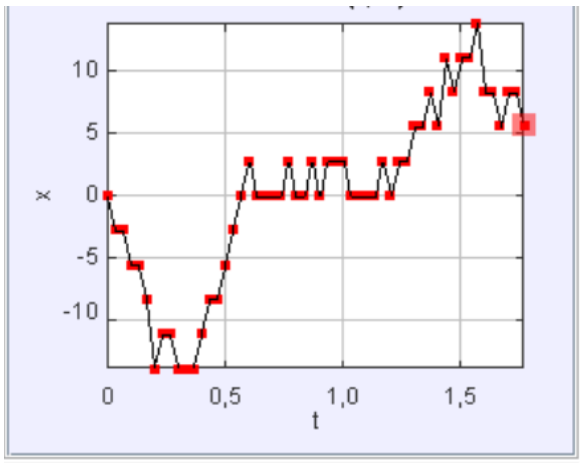
temperature. Viscosity inversely proportional to temperature. If the temperature goes up then the viscosity will go down and so will the on the contrary.

Research Data on Temperature Variations

The graph of the analysis results when the ball falls in the tracker software can be seen in the image below. Figure (a) is the result of the analysis at a temperature of 27 ^{0}C, figure (b) is the result of the analysis at a temperature of 16 ^{0}C and figure (c) is the result of the analysis at a temperature of 82^{0}C.



(a)



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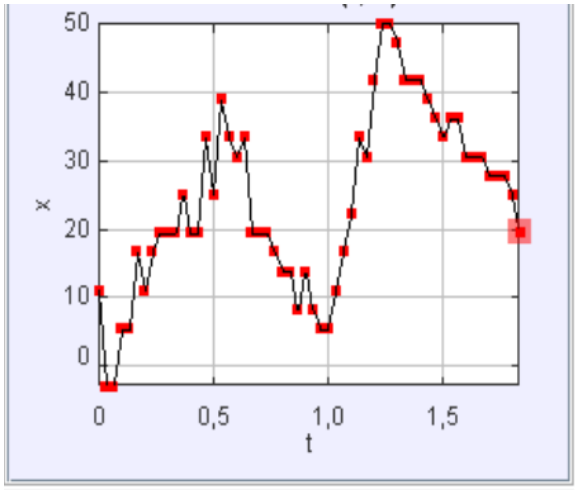


(c)

Figure 2 time ball falls graph of temperature (a) 27ºC, (b) 16ºC, (c) 82ºC

From the figure 2 can be conclude if low temeprature viscosity is increas. And if hight temperature viscosity is to down. Because temperature is inversely related to viscosity. Like viscosity increas if hight temperature. If the temperature increases, the viscosity will decrease, and vice versa. So it can be concluded that temperature has an effect on viscosity. The greater the fluid temperature, the lower the viscosity.

From table 1 can be conclued temperature is inversely related to viscosity. Like viscosity increas if hight temperature.If the temperature increases, the viscosity will decrease, and vice versa. So it can be concluded that temperature has an effect on viscosity. The greater the fluid temperature, the lower the viscosity. In other words, the temperature of the fluid is inversely related to the viscosity. A fluid will generally experience a decrease in viscosity in the presence of temperature (Lumbantoruan & Yulianti, 2016*)* . This opinion is also supported by(Putri & Kasli, 2017) say that temperature is inversely proportional to viscosity. If the temperature rises then the viscosity will be down, and vice versa. The concentration of the solution is directly proportional to viscosity. A solution with a high concentration will have a high viscosity too, because of the concentration of the solution expresses the number of particles of

dissolved substance per unit volume. The more particles that are dissolved, the higher the friction between the particles and the higher the viscosity. Viscosity is directly proportional to the molecular weight of the solute. Because the solute will be heavy inhibits or puts a heavy load on the liquid so as to increase the viscosity. In his research (Didik Lalu A, 2017) on the measurement of the specific heat of the material by using a modified Stefan Boltzmann's Theorem, it is stated that if an object is heated to a high temperature, it will emit electromagnetic waves. Where electromagnetic waves are waves that do not require a medium in their propagation. If the object is heated through the propagation medium it will deliver good heat. Likewise in measuring the viscosity of nira water. If the nira water is heated it will produce a low viscosity level. And research of (Sahasrabudhe et al., 2017) can be conclued temperature is take effect with viscosity. Working liquid viscosity dramatically depends on the temperature, like viscosity increas if hight temperature (Dobrokhodov & Petrov, 2019).

In this study, I measured the viscosity of water at high temperature at 82 C degrees of heat . Where at this position, the nira has begun to thicken again, from the heating process at 100 C. Researchers can conclude from the results of their observations that it is true at this temperature. 100 C of nira water is indeed very liquid and when the researcher observed the time when the ball fell he measured it at a temperature of 82 C. At 82 C the thickness of the nira water was getting thicker, because it had decreased in temperature and was in the process of being frozen. Because the nira water is heated, the water content in the nira evaporates, due to the very light density of water. Where in the food there is free water and bound water. Free water will be lost if it evaporates and bound water will be difficult to remove from the food even by drying it. Likewise with the heating process of nira water. In the nira water, the nira-free water will evaporate and the bound water will thicken. Then the researchers also measured the time when the ball fell in the

Table 1. temperature variation research results

Tempreture Trial	Time the ball falls	Viscosity Coefficient	η is Average	Devinition	Correctiom
16ºC	1	1,77 second $5,09x10^{-10}$	$5,09x10^{-10}$	$0,02x10^{-10}$	0,4%
	2	1,77 second $5,03x10^{-10}$			
	3	1,75 second $5,09x10^{-10}$			
27ºC	1	1,70 second $5,09x10^{-10}$	$4,86x10^{-10}$	$0,02x10^{-10}$	0,4%
	2	1,68 second $4,89x10^{-10}$			
	3	1,69 second $4,83x10^{-10}$			
82ºC	1	1,83 second $5,26x10^{-10}$	$5,26x10^{-10}$	0	0%
	2	1,83 second $5,26x10^{-10}$			
	3	1,83 second $5,26x10^{-10}$			

nira at 16ºC, where the researchers concluded that the consistency of the nira water was thicker than 27ºC. Because the cooled liquid will freeze, and if it is allowed to stand again at room temperature, such as temperature. 27ºCwill again melt. Because indeed the cycle if the fluid is heated it will melt, and cooled down again, it will thicken. And if you put it back at room temperature, it will melt again.

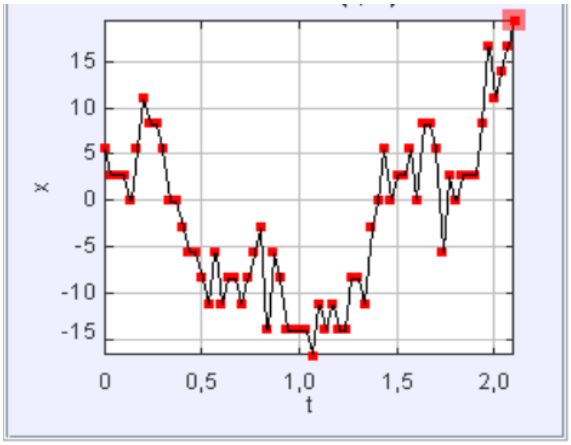
Likewise, from the results of observations, researchers can observe that when the nira boils at boiling water temperature is more liquid than before. And it thickens again when the nira is below the boiling temperature of water, for example what the researchers measured at 82ºC. At this temperature the nira has solidified again. And when the researchers stored the juice in the refrigerator, the water became thicker than at room temperature. The viscosity of the nira is at a temperature of 16ºC> 27ºC. because at a temperature of 27ºC the nira again melts after the compaction process is at 16ºC.

As for what causes the nira water stored at low temperature (cold temperature) will be slightly thicker with the nira water stored in an open room, because if outside the room within 90 minutes after the tapping process will make it more acidic due to fermentation by the bacteria Saccharomyces sp . thickness. In general, cooling will inhibit microbial growth. Except psychhrophilic microbes . However, cooling cannot stop the microbial metabolic activity. However, with cooling treatment, microbial metabolic activity will take place rather slowly, which is indicated by a decrease in growth rate. The way to determine the effect of temperature on viscosity is by varying the temperature of the nira water. Where temperatures 16ºC, 27ºC and 82ºC. Then the researchers measured the time the ball fell by using a video-based laboratory, namely by shooting the ball dropped in a glass of nira water. Then the video is analyzed in the tracker software and after getting the ball drop time results. Researchers calculated how big the viscosity coefficient of the juice is with the viscosity coefficient equation.

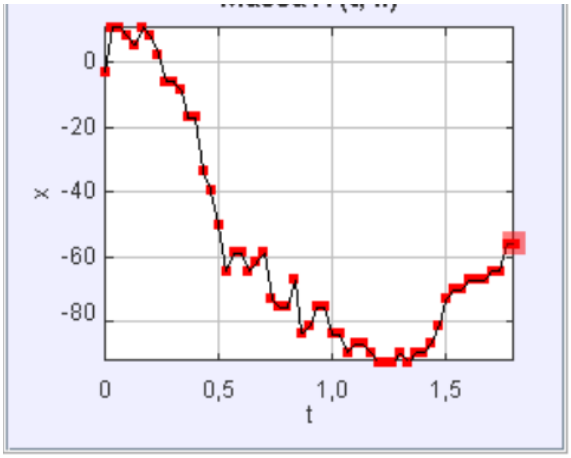
And influence temperature hight (82ºC) for coefficient viscosity of nira water because the nira water is heated the water content in the nira evaporates, due to its density very light water. Where in the food there is is water free and water bound. Free water will be lost if evaporates and water bound to be difficult to remove from the food, even thought by drying. Likewise with water heating process nira in the nira water, the nira-free water will evaporate and the bound water will viscous. So can be conclude the higher the temperature of fluid, the viscous it will be. And lower a fluid, the more fluid it is.

Research Data on Concentration Variation

The graph of the analysis results when the ball falls in the tracker software can be seen in the image below. Figure (a) is the result of analysis on pure nira, Figure (b) is the result of analysis on Nira Water + mineral water and Figure (c) is the result of analysis on Nira



(a)



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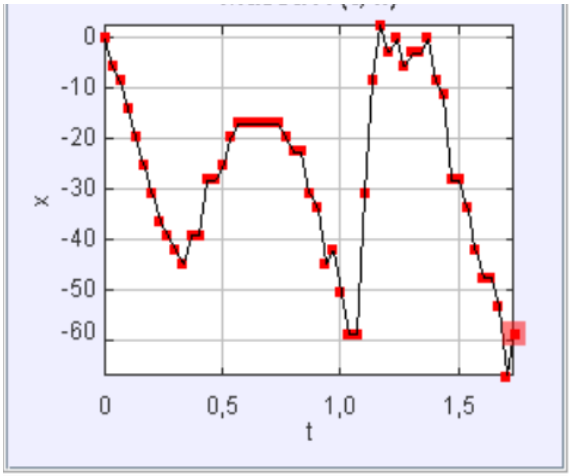


(c)

Figure 3 (a) time ball falls graph of pure nira water, (b)time ball falls graph of nira water+ mineral water, (c)time ball falls graph of nira water + coconut water

From the figure 3 can be conclude if pure nira water have values of viscosity is increas. And if nira water mixed with other fluid values of viscosity is to down. Because concentration has an effect on viscosity. And high concentration will have a high viscosity as well, because the concentration of the solution states the number of dissolved particles per volume unit.

From table 2 can be conclued one of the factors that influence the water viscosity is concentration. In research of (Azmi et al., 2012)also can be conclued viscosity increas with volume concentration.Where a solution with a high concentration will have a high viscosity as well, because the concentration of the solution states the number of dissolved particles per volume unit. The more particles dissolved, the higher the friction between the particles and the higher the viscosity. As for other researchers who have examined fluid viscosity and know that concentration affects viscosity, (Wahyuni et al., n.d.) he concluded that the increasing the viscosity concentration the higher the viscosity. (Prisma, 2012) also said that concentration has an effect on viscosity. Where in the research that researchers have done, they also found the same thing. Where the researchers found the

Table 2. Research results of concentration

Concentration Trial	Time the ball falls	Viscosity Coefficient	η is Average	Devinition	Correctiom
140 ml of Nira water	1	2,10 second $5{,}09\text{x}10^{-10}$	$6{,}06\text{x}10^{-10}$	$0{,}02\text{x}10^{-10}$	0,3%
	2	2,10 second $5{,}03\text{x}10^{-10}$			
	3	2,12 second $5{,}09\text{x}10^{-10}$			
90 ml nira + 50 ml of mineral water	1	1,80 second $5{,}09\text{x}10^{-10}$	$5{,}18\text{x}10^{-10}$	0	0%
	2	1,80 second $4{,}89\text{x}10^{-10}$			
	3	1,80 second $4{,}83\text{x}10^{-10}$			
90 ml nira + 50 ml of coconut water	1	1,75 second $5{,}26\text{x}10^{-10}$	$5\text{x}10^{-10}$	$0{,}2\text{x}10^{-10}$	4%
	2	1,72 second $5{,}26\text{x}10^{-10}$			
	3	1,77 second $5{,}26\text{x}10^{-10}$			

water viscosity is high at high concentration. In contrast to the research of the ielectric constant conducted by (Didik Lalu A, 2017) which states that the dielectic constant will decrease if the concentration increases. Viscosity actually increases the higher the concentration.

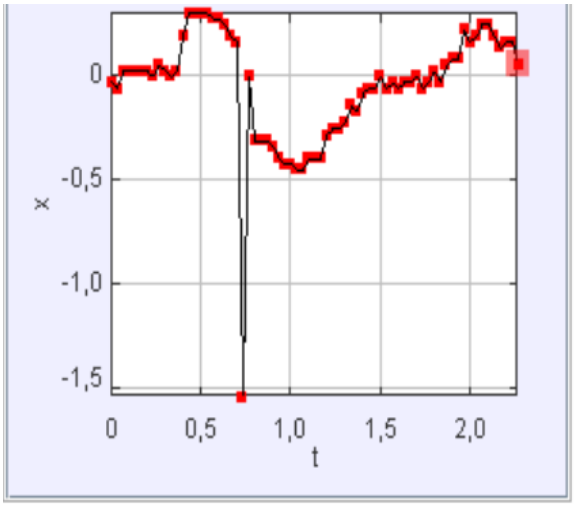
Research that proves that viscosity will increase if the concentration is higher is research (Didik et al., 2014)which states that changes in solution concentration are proportional to changes in the thickness of the polystyrene layer formed. This is because the concentration of the solution affects the viscosity of the polystyrene solution. The higher the concentration of the solution, the viscosity of the solution increases as well. The viscosity of each solution concentration also affects the thickness of the ZnPc layer. The higher the viscosity of the polystyrene solution, the more cavities formed in the polystyrene layer will also increase.

The way to determine the effect of concentration on viscosity is by mixing pure nira water with coconut water and mineral water. Here the researchers compared how thick the pure nira was, the juice was mixed with coconut water and the juice was mixed with mineral water. Then the researchers measured the time when the ball fell using a video-based laboratory, namely by filming the ball being dropped in a glass of nira water. Then the video is analyzed in the tracker software and after getting the ball drop time results. Researchers calculated how big the viscosity coefficient of the juice is with the viscosity coefficient equation.

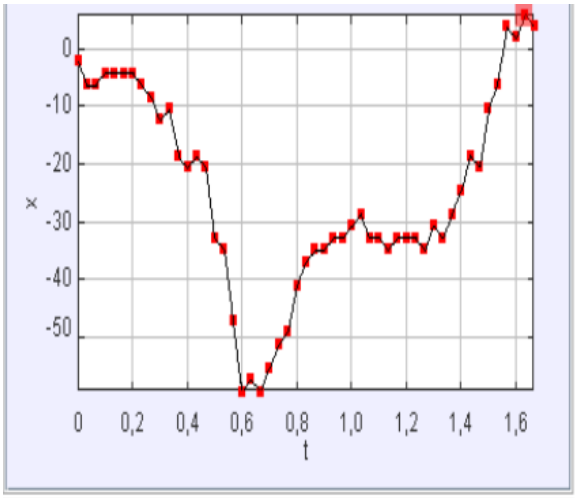
So can be conclude the higher fluid concentration will make higher of viscosity coefficient value, and lower of fluid concentration will make loweer of fluid viscosity coefficient value.

Research Data on Variation of Fermentation Time

The graph of the analysis results when the ball falls in the tracker software can be seen in the image below. Image (a) is the result of analysis on the fermentation day 7, the image of your (b) is the result of analysis on a long fermetasi day 9and image (c) is the result of analysis on the fermentation day 11.



(a)



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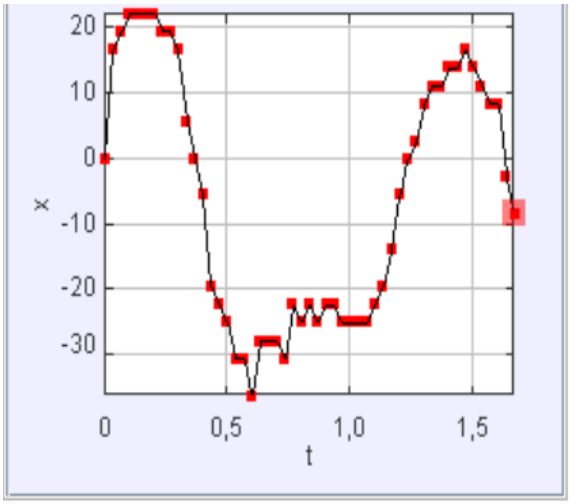

(c)

Figure 4 (a) time ball falls graph of fermentation day 7, (b) time ball falls of

fermentation day 9, (c)time ball falls graph of fermentation day 11

From figure 4 can be concluted fermentation is one of influence for viscosity. And if longer time of fermentation is to down values of viscosity.

From table 3 can be concluedin this study, the researchers also observed whether the fermentation time could cause a large change in the value of the viscosity coefficient of nira water. And after the researchers made observations, it is true that the storage time for nira water (fermentation) can cause a decrease in the value of the viscosity coefficient. It can be seen from the table of observations, it is found that the fermetation of the 7th, 9th and 11th days is decreasing.

The method of measuring the viscoidity coefficient of nira water was varied by storage time, namely by fermenting the juice for 7 days, 9 days and 11 days. After storing the juice for a certain period of time, the researcher then conducted an experiment using the ball drop time method. Researchers measured the time when the ball fell using a video-based laboratory, namely by filming the ball being dropped in a glass of juice. Then the video is analyzed in the tracker software and after getting the ball drop time results. Researchers calculated how big the viscosity coefficient of the juice is with the viscosity coefficient equation.

The research results that the researchers got were the same as the research results (Assah & Indriaty, 2018) , who examined the effect of the storage time of nira water on the quality of the palm sugar obtained, where he also carved the viscosity with the falling ball method with a viscometer. Where in her research, Yunita said that storing nira water or fermentation of nira water would make the water content even higher. This means that the sugar content causes the viscous juice water to fade so that only water is left, so that as it is fermented the higher the water content causes the juice to melt away.The size of the resistance caused by the substance liquid can be affected by the type of liquid used or the

Table 3. Research results of fermentation time variations

Fermentation time trial	Time the ball falls	Viscosity coefficient	η is Average	Devinition	Correctiom
7 day	1	2,27 second $5{,}09\text{x}10^{-10}$	$6{,}51\text{x}10^{-10}$	$0{,}02\text{x}10^{-10}$	0,3%
	2	2,25 second $5{,}03\text{x}10^{-10}$			
	3	1,67 second $5{,}09\text{x}10^{-10}$			
9 day	1	1,67 second $5{,}09\text{x}10^{-10}$	$4{,}80\text{x}10^{-10}$	0	0%
	2	1,67 second $4{,}89\text{x}10^{-10}$			
	3	1,67 second $4{,}83\text{x}10^{-10}$			
11 day	1	1,67 second $5{,}26\text{x}10^{-10}$	$4{,}80\text{x}10^{-10}$	0	0%
	2	1,67 second $5{,}26\text{x}10^{-10}$			
	3	1,67 second $5{,}26\text{x}10^{-10}$			

size and mass of the solid dropped. If the type of liquid used is the same, it will have a big effect the size of the resistance is determined by the size and mass of the object being dropped. The greater it is the resistance given will result in the slower speed of the metal ball. Conversely, if the smaller the resistance posed by the liquid, the faster it will fall. The size of the resistance caused by a liquid is called the viscosity or viscosity (Hantoro, 2014).

From research of fermentation nira water will make the water content ever higher. This means that the sugar content causes the viscous nira to fade so that only water is left, so the fabric is fermented the higher the water content which causes the nira water to be even more melt.

And the good viscosity level of nira water can be seen the result of research on pure nira water. Because researchers can confirm the authenticity of pure nira water is approaching 100 percent.

CONCLUSION

Measuring the time the ball fell using a video-based laboratory-based falling ball method with tracker software was done by making a video of the ball being dropped in nira water. Then after the video is obtained, the video is analyzed in the tracker software to obtain the value of the ball drop time needed to calculate the value of the viscosity coefficient. Determining the viscosity of nira water with various concentrations using a falling ball method based on a video-based laboratory with tracker software is done by varying the concentration of nira water and mixing the nira water with coconut water and mineral water. Then analyze the falling ball video in the tracker software to get the time value of the ball, to calculate the viscosity coefficient value using the viscosity coefficient equation. The relationship between the concentration of nira water and viscosity is that a solution with a high concentration will also have a high viscosity, because the concentration of the solution states the number of dissolved particles per volume unit. The more particles dissolved, the higher the friction between the particles and the higher the viscosity.

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