carrageenan with a slight increase of citric acid can decrease total acid. According to [20], this is because the OH group in carrageenan (hydrocolloid) can bind water so that it can reduce the total acid. In addition, carrageenan also has potassium, potassium, magnesium, and sodium, which react with acids to form salts. Salt is bound with carrageenan, which can reduce acidity

3) Antioxidant Activity:

Antioxidants are components of nutritional and non-nutritional content in foodstuffs and function to prevent or prevent oxidative damage in the body. According to the study results, the interaction of carrageenan and citric acid with the antioxidant activity of moringa jelly extract showed no significant difference. Table 1 shows that the addition of carrageenan is the same as the addition of citric acid (not significant). According to [21], Carrageenan, especially kappa-type carrageenan, functions as a micro encapsulant, increasing the adhesion between the wall and core materials to protect the antioxidant compounds contained in the beverage jelly from being affected by heating or thermal processes.

The resulting antioxidant activity was 63.01%, 63.69%, 62.65%, 62.81%, 63.69%, and 61.97%, respectively. This is because moringa leaf flour is as much as 0.2 g, so the resulting antioxidant capacity in each treatment in that range is the same. The results of the analysis obtained referred to [22] that content of the antioxidant activity of leaf extracts Moringa has an antioxidant power of 35,777 ppm while the antioxidant compounds of Moringa leaves of 239.42 ppm, such as tannins, steroids, triterpenoids, phenolics, flavonoids, saponins, and alkaloids.

4) pH:

The measurement of acidity expressed by pH is critical because it affects the occurrence of sucrose inversion in the product. According to the results of the study, it was found that the interaction between the addition of carrageenan and citric acid had no significant difference in the pH value of the Moringa leaf jelly drink. The addition of carrageenan and citric acid had a significant effect on the pH of the Moringa leaf jelly drink. The pH values obtained ranged from 2.80 (0.4% carrageenan concentration and 0.2% citric acid) – 3.57 (0.2% carrageenan concentration and 0.1% citric acid). Table 1 shows that the addition of citric acid can decrease the value of the pH.

According to [23], citric acid is acidic and has a low pH, so adding citric acid to the product can cause the resulting product to have acidic properties. The results of this study are by research from [24] revealed that the pH value obtained was around 5.80 due to the loss of volatile compounds and total acid from mulberry pectin on heating and adding a thickening agent to reduce acidity. The total gelling concentration and the proportion of pouring flour and carrageenan added to increase the pH so that the pH becomes more alkaline. According to [25] The higher concentration of carrageenan increases the pH value of the jelly drink. This is because the carrageenan extracted from the alkaline solution of seaweed sap tends to have an alkaline pH, which can increase the pH value from 9.5 to 10.5.

5) Mineral:

Analysis of mineral content using Atomic Absorption Spectrophotometry. Based on the results of the study, it was shown that there was a significant difference between the interaction of adding carrageenan and citric acid to the levels of Ca, Zn, and Fe in the Moringa jelly drink. The analysis results showed that the concentration of carrageenan and citric acid had different effects on the Ca (calcium) of Moringa leaf jelly drinks. The obtained Ca mineral values ranged from 111.72 ppm (concentration of 0.3% carrageenan and 0.2% citric acid) – 380.61 ppm (concentration of 0.2% carrageenan and 0.1% citric acid).

Table 1 shows this increase was due to the relatively high levels of the mineral Ca contained in each component of the materials used, for example, carrageenan and moringa leaf powder. According to [26] Carrageenan is a galactose polysaccharide extracted from seaweed; some carrageenan contains sodium, magnesium, and calcium bound to galactose ester sulfate groups and 3,6- anhydrous-galactose copolymers. Based on research from [22] It was found that Moringa leaf flour had a Ca mineral content of 16350.58 ppm, which caused very high Ca mineral levels ranging from 111.72 ppm to 380.61 ppm. This is by research from [27] that the calcium content in crackers of 324 mg/100 g is relatively high as a mineral source, this is due to the substitution treatment of moringa leaf flour. In the mineral content analysis, carrageenan and citric acid concentrations had different effects on the Zn (zinc) of Moringa leaf jelly drinks. The Zn values obtained ranged from 7.01 ppm (0.2% carrageenan and 0.2% citric acid) – 39.45 ppm (concentration of 0.3% carrageenan and 0.2% citric acid).

Table 1 shows the results of the analysis of the Zn content (Zinc), which is quite high in the K2 treatment, namely 7.01 ppm each, 39.45ppm, and 34.97 ppm compared to the addition of K1 citric acid (0.1% concentration). The increase in Zn mineral is caused by citric acid reducing the amount of phytic acid contained in the content of Moringa leaf powder by (0.001-0.49%) to increase the Zn content. Based on research [28], which led to a decrease in the addition of citric acid phytic acid to corn feed to increase the bioavailability of Zn because phytic acid is an anti-nutrient mineral binding compound and the acidic nature will react with minerals and will decompose. Therefore, Zn binds with phytic acid to form insoluble complexes. In the results of the Fe (Iron) mineral content analysis, both treatments had a significantly different effect on the Fe content of the Moringa leaf jelly drink. The values of Fe obtained ranged from 0.43 ppm (concentration of 0.2% carrageenan and 0.1% citric acid) – 3.25 ppm (concentration of 0.4% carrageenan and 0.2% citric acid).

Table 1 shows an increase in the mineral content of Fe (iron) in the Moringa leaf jelly drink in line with the rise in carrageenan and citric acid. This is based on research from [29] that there is an increase in ash content due to the addition of seaweed powder or carrageenan because carrageenan contains minerals contained in seaweed. The addition of these minerals, such as Ca, Cu, and Fe, as well as the ash content of a material, is related to the mineral content of the material. Another study from [30] found an increase in ash content in dairy buffalo because seaweed contained the minerals Na, K, Cl, Ca, Mg, Fe, I, and S, which were relatively high. And what is used as the main ingredient is carrageenan.

B. Physical Parameters

1) Viscosity:

Viscosity is the degree of thickness of a food product. Viscosity is a fluid property and measure of fluid viscosity, which states the size of the friction in the fluid. Viscosity describes the fluid's resistance when flowing. The higher the value of the viscosity coefficient, the higher the fluid resistance to flow. According to [31], the study's results showed a significant difference in the interaction of adding carrageenan and citric acid to the viscosity of the Moringa leaf jelly drink. The treatment of adding carrageenan had a significantly different effect.

The viscosity of the moringa leaf jelly drink is the same as the addition of citric acid, which gives a significantly different effect. The viscosity values obtained ranged from 3.73 cPs (0.3% carrageenan and 0.2% citric acid) – 17.73 cPs (concentration of 0.4% carrageenan and 0.1% citric acid). Table 2 shows that the decrease in viscosity caused the reduction in citric acid. This is based on research from [32], that an increase in citric acid can cause a decrease in gel strength through breaking bonds in the three-dimensional matrix formed by the kappa carrageenan complex. Carrageenan gel will be stable at neutral to alkaline pH; if the pH is below 4.3, namely 3.60, anhydrous-D- galactose undergoes autohydrolysis, which decreases viscosity. However, the more carrageenan is added, the viscosity value will increase. According to [33] Increasing the concentration of carrageenan will increase viscosity. This is due to the free water contained in the pineapple jelly drink, where the hydrophilic carrageenan group molecules attach to form a gel. The higher the carrageenan, the greater the amount of free water that is absorbed and bound so that the jelly becomes stronger.

2) Color:

Color is an essential quality attribute in ingredients and food products. The ˚Hue value represents the dominant wavelength determining a material's color. According to the study's results, the interactions between the addition of carrageenan and citric acid had no significant effect on the color (˚Hue) of the Moringa leaf jelly drink. Table 1 shows that the treatment of adding carrageenan (non-significant) is the same as the addition of citric acid (non-significant).

The ˚Hue value of the resulting moringa leaf jelly drink ranges from 120.42˚ in quadrant III (Yellow) to 128.84˚ in quadrant III (Yellow Green). The non-significant difference in ˚Hue is thought to be caused by citric acid, which can stabilize the color of jelly drinks. Besides, Moringa leaf extract contains antioxidants and tannins, which, when reacted with citric acid, the color changes to brownish yellow [34], as the characteristic of condensed tannins.

3) Turbidity:

Turbidity can be interpreted as a measure of the relative clarity of water. Turbidity is not a direct measure of suspended particles in water but a measure of the scattering effect of these particles on light [35]. According to the study's results, it was found that the interaction between the of adding carrageenan and citric acid had no significant difference in the turbidity of the Moringa leaf jelly drink. However, the addition of carrageenan and citric acid had a significant effect. The turbidity values obtained ranged from 86 ntu (0.3% carrageenan and 0.2% citric acid) – 114.67 ntu (concentration of 0.4% carrageenan and 0.1% citric acid).

Table 1 shows a decrease in turbidity with the addition of citric acid. The higher the citric acid used in the jelly drink, the lower the turbidity level will be. According to [36] that citric acid has a reasonably good resemblance because its solubility in water is high enough to maintain the turbidity and clarity of the resulting gel. Therefore, the greater the concentration of citric acid used, the more turbidity it can support and reduce in the Moringa leaf jelly drink.

However, adding carrageenan resulted in an increase in turbidity in the Moringa leaf jelly drink. The increase in turbidity level occurs because there is still a small amount of precipitate that is filtered out during the filtering process, which causes the color of the liquid to become cloudy. This precipitate comes from the hydrocolloid material in the form of carrageenan, which is used. According to [37] that the more hydrocolloid concentration added, the greater the level of solubility. This is because the number of hydroxyl groups increases with increasing hydrocolloid concentration, so the rate of water binding is easier and faster. Turbidity also occurs because of the possibility of high viscosity, so it looks more turbid. This is by research from [38] that to get a straightforward product, it must be turbid.

C. Organoleptic Parameter

1) Taste:

Taste is a subjective sensory attribute to the sense of smell because everyone has a different sensitivity. According to the study's results, the interaction between carrageenan and citric acid addition showed no significant difference in the hedonic test and scoring of the Taste of Moringa leaf jelly drink. However, the addition of carrageenan had a significantly different effect on the scoring of the aroma of the moringa leaf jelly drink.

Table 1 shows that the results of the scoring test for the Taste of the Moringa leaf jelly drink ranged from 2.45 to 3.00 with the criteria of not unpleasant to somewhat unpleasant. According to [29], adding carrageenan and citric acid did not have a significantly different effect because the higher the carrageenan concentration, the lower the aroma value. Based on the interaction scoring test, adding carrageenan and citric acid did not significantly affect the moringa leaf jelly drink. The aroma is due to the unpleasant aroma of the ingredients used, namely the smell of Moringa leaves. In addition, this was also because the list of panelists who conducted the aroma scoring test were semi-trained, so the panelists did not know the specific aroma of Moringa leaf jelly drinks in general.

2) Texture:

Texture is an attribute of a substance that results from a combination of various physical properties and is perceived by the senses of touch, sight, and hearing. These physical properties can be the constituent structural elements' shape, size, number, nature, and conformation. According to the study results, there was no significant difference between adding carrageenan and citric acid in hedonic testing and texture scoring of Moringa leaf jelly drinks. However, the treatment with the addition of carrageenan had a significantly

different effect on the hedonic test and texture scoring of the Moringa leaf jelly drink.

Table 1 shows that the level of scoring (scoring) carried out by a list of 20 panelists had an effect that was not significantly different from the average panelist giving scores in the range of 4.20-4.65 (Slightly quickly aspirated or slightly dense – Very quickly aspirated, slightly dilute) with the highest value of 4.65. Adding carrageenan significantly affected the hedonic and texture scoring of the Moringa leaf jelly drink. The more carrageenan added, the chewier the texture of the Moringa leaf jelly drink. According to [39], at lower levels of carrageenan, it tends to produce a brittle gel so that the texture of this jelly drink is not felt when sucked.

3) Flavor:

Taste is an important parameter determining whether a product is acceptable according to consumer desires. According to the study results, there was no significant difference between adding carrageenan and citric acid on the hedonic test and scoring the flavor of Moringa leaf jelly drinks. However, adding carrageenan and citric acid significantly affected the hedonic test and texture scoring of the Moringa leaf jelly drink, with the average panelist giving a value of 2.65-3.90 (somewhat like it). The level of preference for taste in this Moringa leaf jelly drink is influenced by the addition of citric acid. According to [40] Taste is influenced by several factors, including concentration and its interaction with other taste components such as sugar or flavors. Flavors and citric acid give a sour taste while adding carrageenan and sugar can provide a sweet taste. The more carrageenan is added, the stronger the sweet taste. Therefore, the scoring test values obtained from sour to slightly sour taste are due to a mixture of citric acid and carrageenan.

4) Color:

Color is an important parameter because of the physical or sensory properties that consumers first see. Color involves the sense of sight more and is one of the indicators that determine whether or not food is accepted by consumers. According to the study's results, the interaction between adding carrageenan and citric acid had no significant difference on the hedonic test and scoring the color of Moringa leaf jelly drinks. Table 1 shows that the treatment of adding carrageenan (non-significant) is the same as the addition of citric acid (non-significant). The highest value was 3.70. The results of the color preference test based on the level of judgment (hedonic) gave an effect that was not significantly different. The level of color preference in the Moringa leaf jelly drink is influenced by the color of the additional ingredients, namely the added lemon flavor. According to [41]The yellowish-white color of carrageenan and white crystalline citric acid have no effect on the resulting product because it is dominated by the color of the additional ingredients used, namely lemon flavor.

The main research stage is on quality chemical, physical, and organoleptic properties. Moringa jelly drink produces the best P3K1 treatment with carrageenan addition concentration 0f 0,4% and citric acid 0,1%. This can be seen from the results the research obtained is fiber content 1966%; total acid 2.63%; pH 3.14; minerals Ca 275.19 ppm; mineral Zn 30.71 ppm; mineral Fe 1.44 ppm, activity antioxidants 63.69%; viscosity 17.73 cPs; color 127/23 (yellow-green); turbidity 114.67 ntu; slightly sour taste; not flavorful unpleasant; orange in color and has a texture easily aspirated or semi-solid.

D. Shelf-Life Research Results

The process of storing Moringa leaf jelly drink with P3K1 treatment (added concentration of 0.4% carrageenan and 0.1% citric acid) was carried out for 12 days using hot filled PET bottles. Then stored at 3 different temperatures, namely 10˚C and 30˚C.

1) Critical Parameters of Moringa Leaf Jelly Drink:

In this study, the critical parameters of Moringa leaf jelly drink were determined by involving 20 panelists to select essential parameters that were considered critical parameters of damage to Moringa leaf jelly drinks, such as aroma, texture, taste, and color. The crucial point observations showed that the longer the storage, the lower the level of preference of the panelists for the moringa leaf jelly drink. This is by research conducted by [42], which states that the longer and higher the sample temperature is stored, the lower the average hedonic score will be. The hedonic test was set on the panelist's preference score for aroma, texture, taste, and color, namely a score of 2 "dislike." This was due to the condition of the Moringa leaf jelly beverage product, which was considered to have been rejected for consumption by the panelists.

2) Changes in pH:

Figure 1 shows changes in pH values stored at various temperature variations. The longer the storage time, the higher the pH value of the product. The pH value in PET hot fill bottles during storage tends to increase at both temperatures, namely 10˚C and 30˚C. It is suspected that the longer the shelf life of the jelly drink, the more water components will come out. With increased water components in this drink, the pH value increases. The increase in pH is due to the large number of water components in the jelly drink during the shelf life, and the longer the osmosis time, the more water is extracted from the cells [29].

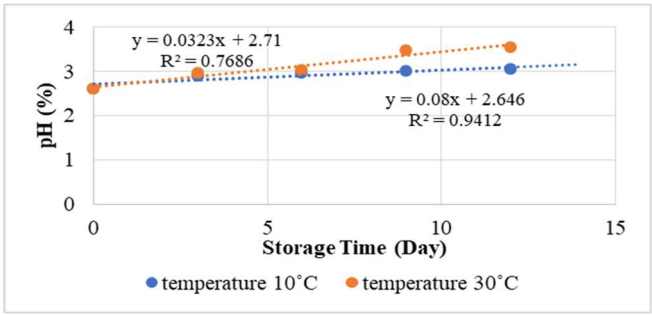

Fig. 1 Curve of relationship between storage time and pH value of Moringa Leaf Jelly Drink

TABLE II
PH VALUE OF MORINGA LEAF JELLY DRINK DURING STORAGE

Storage Time (Days)	Storage Temperature		
	10˚C	30˚C	Tipping Point
	pH value		
0	2.61	2.61	2.61
3	2.90	2.96	3.24
6	2.96	3.03	3.26
9	3.01	3.48	3.90
12	3.04	3.55	3.91

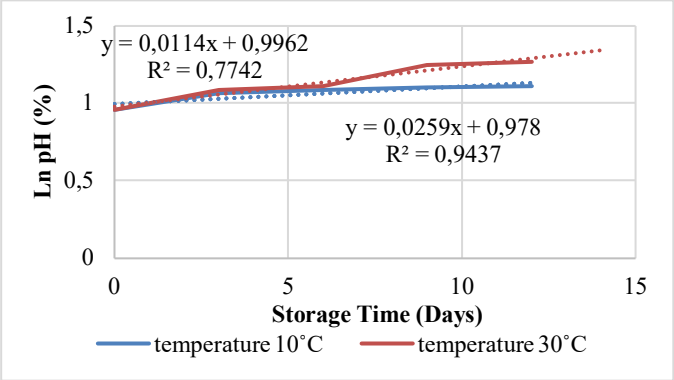

Fig. 2 Curve of relationship between storage time and Ln pH value of Moringa Leaf Jelly Drink

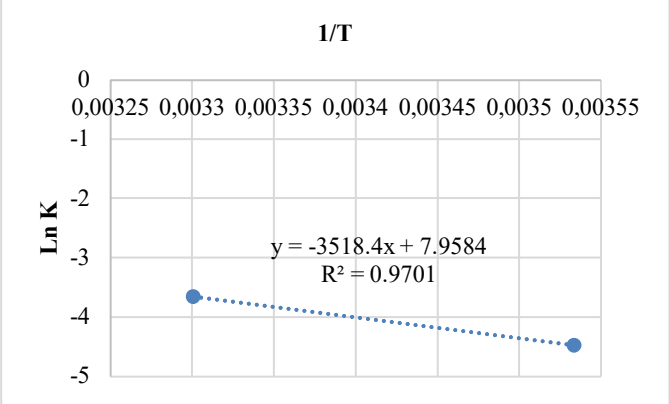

Fig. 3 Graph of Arrhenius Equation Determination

TABLE III
DETERMINATION OF THE SHELF LIFE OF MORINGA LEAF JELLY DRINKS

Temperature (˚C)	Critical Point	Initial pH Value	K	Shelf life (Days)	Shelf life (Months)
10˚C	3.91	2.61	0.0114	114.035	4 months
30˚C	3.91	2.61	0.0259	50.193	2 months

3) Estimation of Shelf Life:

In determining the shelf life of Moringa leaf jelly drink products using the Arrhenius model, Table 2 shows the linear regression equation parameter of the pH value of Moringa leaf jelly drinks at various storage temperature variations. Reaction order 0 shows a linear relationship between pH value data and storage time (days). In contrast, reaction order 1 shows a linear relationship between Ln pH value at each storage temperature and storage time (days). The curve used to make the Arrhenius graph can be seen from the value of the correlation coefficient (R2). The most considerable R2 value will be used to determine the Arrhenius equation.

According to the calculation results of the shelf life of the moringa leaf jelly drink in (Table 3), the longest shelf life was obtained at 10˚C, which was 23 days, then at 30˚C, which was 10 days. This shows that the increase in temperature causes a faster rate of reaction which causes the Moringa leaf jelly drink to spoil quickly so that its shelf life is getting shorter. According to [43] that storage temperature is related to shelf life. Temperature affects the acceleration of damage or a decrease in product quality, where the higher the storage temperature, the greater the speed of deterioration resulting in shorter shelf life. The use of hot fill PET bottles is one of the factors that extends the shelf life of Moringa leaf jelly drinks. Packaging is a process of packaging, container, or packing a product using certain materials so that the product inside can be accommodated and protected, while product packaging is part of the packaging of a product that is inside. This packaging is one way to preserve or extend the life of the food or food products contained therein. Of the several types of packaging, some of which are plastic and glass packaging. Types of plastic packaging include HDPE and PET. For PET plastic packaging, which is also used increasing in the packaging of fruit juices and beverages, it has the properties of being resistant to high temperatures, translucent, strong and not easily torn and has low permeability to water vapor and gas. This is because the lower the permeability to water vapor and gas. This is because the lower the permeability of the packaging, the longer the shelf life of the product.

The processing process is also a factor in a product's quality so that it affects its shelf life. The shelf-life factor of Moringa leaf jelly drinks besides using hot filled PET bottles, can be affected by the pasteurization process. According to [44] pasteurization is a thermal process with a temperature of <100ºC to kill certain vegetative microbes, namely pathogens, and deactivate enzymes. Pasteurization does not kill all vegetative microorganisms and spore-forming microorganisms. To extend shelf life, pasteurized products must be combined with storage at low temperatures, addition of preservatives, modification of packaging, adjustment of pH and aw to control microbial growth... Based on research conducted [14] that for hot fill PET bottle products after cooking the product is also pasteurized after it is in the package, namely pasteurization 70˚C - 90˚C for 15-30 minutes. The luo han guo jelly drink product using hot fill PET bottles which is pasteurized for 30 minutes at 90˚C has a shelf life of 42 days when viewed from microbiological and color criteria.

IV. CONCLUSION

The treatment with the addition of carrageenan and citric acid produced the best quality moringa leaf jelly with a crude fiber of 19.66%, total acid of 2.63%, pH 3.14; Ca 275.19 ppm; Zn 30.71 ppm, Fe 1.44 ppm; antioxidant activity; viscosity 17.73 cPs; color 127.23 (yellow-green); turbidity 114.67 ntu; slightly sour taste; not smell bad; orange in color, and has an easily aspirated or semi-solid texture. Based on the analysis of the estimation of shelf life for the best treatment, it was found that the shelf life was packaged using hot-filled PET bottles with a temperature of 10˚C and 30˚C, twenty-three days, and ten days, respectively.

ACKNOWLEDGMENT

We gratefully acknowledge the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia for research funding through the Matching Fund Scheme Program and the Faculty of Food Technology and Agroindustry, University of Mataram, for the technical support.

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