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Effects of Chewing Fuji Apple (Malus Domestica) and Jicama (Pachyrhizus Erosus) on Salivary Flow Rate

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ABSTRACT:Changing from a traditional diet to a Western diet such as fast food is a modern lifestyle that can have an impact on unbalanced nutritional intake. The World Health Organization (WHO) recommends a good fiber intake of 25-30 grams per day. The Indonesian population consumes an average of only 10,5 grams of dietary fiber per day, which is still about a third of the ideal requirement. Chewing fibrous foods such as fruits can stimulate the flow rate of saliva as self-cleansing in the oral cavity. Objective: to analyze the effect of chewing, to know the description of the shape and structure of Fuji Apple and Jicama fibers on the salivary flow rate. Method: pre-experiment with one group pretest-posttest design. The sample consisted of 18 subjects and was given two treatments on different days. Saliva was collected before, at 10 and 30 minutes after chewing Fuji Apple and Jicama. The salivary flow rate was measured by weighing the accumulated saliva divided by the time. Results: there was a significant difference in salivary flow rate between before – 10 minutes after, 10 – 30 minutes after, and before – 30 minutes after chewing Fuji Apple and Jicama ($p<0.05$). Structural morphological characterization of Fuji Apple based on SEM tests resembles a wavy surface while Jicama has various kinds of starch granules. The EDX test showed that the oxygen element in Fuji Apple was 70.99% and Jicama was 73.44%. Histological test of Fuji Apples were arranged like a honeycomb pattern while Jicama was square. Conclusion: there was no significant difference between the two treatments ($p>0.05$). If seen from the average of the two treatments, chewing Fuji Apple (0,67) is better than Jicama (0,63) in increasing the salivary flow rate.

KEYWORDS: fibrous fruit, salivary flow rate, scanning electron microscope, energy dispersive x-ray, and microscopy.

I. INTRODUCTION

The change from a traditional diet to a Western diet, such as fast food, which contains lots of calories, fat and cholesterol, is the result of technological and socio-economic developments. Modern lifestyles make teenagers prefer cariogenic foods that contain high carbohydrates and tend to have an impact on unbalanced nutritional intake.[1,2]

The World Health Organization (WHO) recommends a good fiber intake of 25-30 grams per day. The Indonesian population consumes an average of only 10.5 grams of dietary fiber per day. This number shows that it is still about a third of the ideal requirement.[1,3]

Health behavior of Populationis measured based on the frequency and portion of consuming fruit and vegetables. At the age of 5 years and over is calculated from the number of consumption days in a week and the average portion in a day. Population are categorized as 'sufficient' consumption of vegetables and fruit if their minimum intake is 5 servings per day a week.[4]

Based on the 2018'sRISKESDAS(Basic Health Research), the proportion of the Indonesian population that did not consume fruit/vegetables per day a week was 10,7%, consumes 1-2 servings of 66,5%, 3-4 servings of 18,3%, and ≥5 servings only 4,6%. The proportion of the population of North Sumatra who did not consume fruit/vegetables per day in a week was 10,4%, consuming 1-2 servings is 68%, 3-4 servings was 17,5%, and ≥5 servings was only 4,1%. In adolescents (15-19 years) only 3,6% and (20-24 years) 4,3% consumed fruit and vegetables as recommended. This illustrates that the Indonesian population is still not aware of the importance of consuming vegetables/fruits.[4]

Saliva is a liquid exocrine secretion in the mouth that is in contact with the mucosa and teeth. Most of the saliva is produced when eating in response to stimulation due to the influence of tasting and chewing food. Chewing rough, fibrous, watery foods such as fruits can stimulate the salivary flow rate. Fibrous fruits that contain enough water include pineapple, pears, apples,

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strawberries, papaya, watermelon, and jicama.[5,6,7,8]

Apples contain a variety of nutrients including fat, energy, carbohydrates, protein, vitamin A, vitamin B1, vitamin B2, vitamin C, 84% water content, quercetin, and many more. Quercetin in Apples has been shown to inhibit the formation of glucan by Streptococcus mutans thereby inhibiting bacterial cells on the tooth enamel surface. The tannin content in Apples also functions as a natural cleanser for the mouth and prevents tooth decay caused by plaque accumulation.[5,9]

Jicama contains vitamin B1, vitamin C, protein, crude fiber, water content of 78-94%, and carbohydrate content of 12.8%. Antibacterial compounds in fruit including flavonoids, tannins, quinones, saponins, alkaloids, and triterpenoids effectively inhibit the activity of the glucosyltransferase (GTFs) enzyme which is a factor in the development of dental plaque.[5,10,11]

Hanifah et al.'s research results stated that the mean plaque index before chewing Fuji Apple was 2,75 ± 0,78 and after chewing Fuji Apple was 1,06 ± 0,59. The research results of Ni Nyoman Ayu Noviyanti et al. stated that the mean plaque index before chewing Jicama was 1,310 ± 0,706 and after chewing Jicama was 0,617 ± 0,354. These results indicate a significant decrease in the plaque index before and after chewing Fuji Apples and Jicama (p<0,05).[5,12]

The morphology of the fiber structure and the composition of the fruit content can be seen from the Scanning Electron Microscope (SEM), Energy Dispersive X-Ray (EDX), and histology (microscopic). Fuji Apple (Malus domestica) and Jicama (Pachyrhizus erosus) are among the fruits that people generally like because of the sweet, sour taste of Fuji Apples and the crunchy texture of Jicama. Based on the description above, we want to reveal and examine the effect of chewing, shape description, and fiber structure of Fuji Apple (Malus domestica) and Jicama (Pachyrhizus erosus) on the salivary flow rate.

II. RESEARCH METHODS

This type of research was pre-experimental with a one group pretest-posttest design. The sample was 18 students from the Faculty of Dentistry, University of North Sumatra, class of 2020, which were obtained by purposive sampling and random sampling.

Inclusion Criteria

The sample was students of academic education at Faculty of Dentistry, University of North Sumatra, class of 2020, aged 18-25 years, willing to be research subjects, and normal Body Mass Index (BMI), namely, 18,5 – 24,9

Exclusion Criteria

Samples have dental caries that have not been filled except for fissure caries, gingival inflammation such as gingivitis and periodontitis, systemic diseases, consuming alcohol and drugs, and heavy smokers (smoking more than 12 cigarettes in 1 day).

Methodology

Samples will be given an explanation and signed an informed consent for their willingness and participation in this study. Subjects will be instructed to fill out a questionnaire, then given two treatments on different days. Saliva was collected before, at 10 and 30 minutes after chewing 100 g of Fuji Apple with its peel and 100 g of Jicama without peel. The salivary flow rate was measured by weighing the accumulated saliva divided by the time. The movement of biting and grinding food was instructed 32 times between the teeth of the upper and lower jaws with both the right and left sides.

The morphology of the fiber structure and the composition of the fruit content of Fuji Apples and Jicama were seen from the Scanning Electron Microscope (SEM), Energy Dispersive X-Ray (EDX), and histology (microscopic) tests.

III. RESULTS

Table 1 showed the gender of the sample: 11 women (61,1%) and only 7 men (38,9%). The majority of the sample age was 20 years old, namely 13 people (72,2%), then 19 and 21 years old respectively 2 people (11,1%), and 22 years old only 1 person (5,6%). The Body Mass Index (BMI) for all samples was normal in the range of 18,5-24,9.

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Table 1. Demographics Data

Variables		Frequency	
		N(18)	%
Sex	Male	7	38, 9
	Female	11	61,1
Age	19 years old	2	11,1
	20 years old	13	72,2
	21 years old	2	11,1
	22 years old	1	5,5
BMI	Underweight (<18,5)	0	0
	Normal (18,5-24,9)	18	100
	Overweight (25-29,9)	0	0
	Obesitas (>30)	0	0

From a total of 18 subjects in this study, the total salivary flow rate data without stimulation before chewing Fuji Apples was not found in subjects with hyposalivation (0%), low: 10 people (55,5%), normal: 7 people (38,9%)), and hypersalivation in only 1 person (5,5%) with the lowest value being 0,20 ml/minute and the highest being 1,42 ml/minute (Table 2).

Total salivary flow rate data stimulated in the 10th minute after chewing a Fuji Apple did not find subjects with hyposalivation (0%), low: 3 people (16,7%), normal: 11 people (61,1%), and hypersalivation : 4 people (22,2%) with the lowest value being 0,40 ml/minute and the highest being 2,60 ml/minute (Table 2).

In the 30th minute after chewing Fuji Apples, there were no subjects with hyposalivation (0%), low: 4 people (22,2%), normal: 12 people (66,7%), and hypersalivation: 2 people (11,1%) with the lowest value being 0,20 ml/minute and the highest being 1,60 ml/minute (Table 2).

In the Fuji Apple chewing group, the average salivary flow rate before chewing Fuji Apple was 0,53 ± 0,30. At the 10th minute the salivary flow rate increased, namely 0,82 ± 0,49 and decreased at the 30th minute to 0,65 ± 0,30 (Table 2).

Table 2. Saliva Flow Rate Before, at 10th, and 30th Minutes After Chewing Fuji Apples

Saliva Flow Rate (ml/minutes)		Time					
		Before		After			
				10th minutes		30th minutes	
		N	%	N	%	N	%
Category	Hyposalivation (<0,1)	0	0	0	0	0	0
	Low (0,1-0,49)	10	55,5	3	16,7	4	22,2
	Normal (0,5-1)	7	38,9	11	61,1	12	66,7
	Hipersalivation (>1)	1	5,5	4	22,2	2	11,1
N total		18					
Min		0,20		0,40		0,20	
Max		1,42		2,60		1,60	
Mean ± SD		0,53 ± 0,30		0,82 ± 0,49		0,65 ± 0,30	

From a total of 18 subjects in this study, the total salivary flow rate data without stimulation before chewing Jicama with hyposalivation and hypersalivation categories were only 1 person (5,5%), low: 9 people (50%), and normal: 7 people (38,9%) with the lowest value being 0,04 ml/minute and the highest being 1,22 ml/minute (Table 3).

Total salivary flow rate data stimulated in the 10th minute after chewing Jicama did not find subjects with hyposalivation (0%), low: 3 people (16,7%), normal: 11 people (61,1%), and hypersalivation: 4 people (22,2%) with the lowest value being 0,14 ml/minute and the highest being 1,60 ml/minute (Table 3).

In the 30th minute after chewing Jicama, there were no subjects with hyposalivation (0%), low: 5 people (27,8%), normal: 11 people (61,1%), and hypersalivation: 2 people (11,1%) with the lowest value being 0,15 ml/minute and the highest being 1,38 ml/minute (Table 3).

In the Jicama chewing group, the average salivary flow rate before chewing Jicama was 0,51 ± 0,27. At the 10th minute the salivary flow rate increased, namely 0,73 ± 0,35 and decreased at the 30th minute to 0,63 ± 0,32 (Table 3).

Table 3. Saliva Flow Rate Before, at 10th, and 30th Minutes After Chewing Jicama

Saliva Flow Rate (ml/minutes)		Time					
		Before		After			
				10th minutes		30th minutes	
		N	%	N	%	N	%
Category	Hyposalivation (<0,1)	1	5,5	0	0	0	0
	Low (0,1-0,49)	9	50	3	16,7	5	27,8
	Normal (0,5-1)	7	38,9	11	61,1	11	61,1
	Hipersalivation (>1)	1	5,5	4	22,2	2	11,1
N total		18					
Min		0,04		0,14		0,15	
Max		1,22		1,60		1,38	
Rata-rata ± SD		0,51 ± 0,27		0,73 ± 0,35		0,63 ± 0,32	

Figure 1 showed a graph of the salivary flow rate before, at 10 and 30 minutes after chewing Fuji Apples and Jicama.

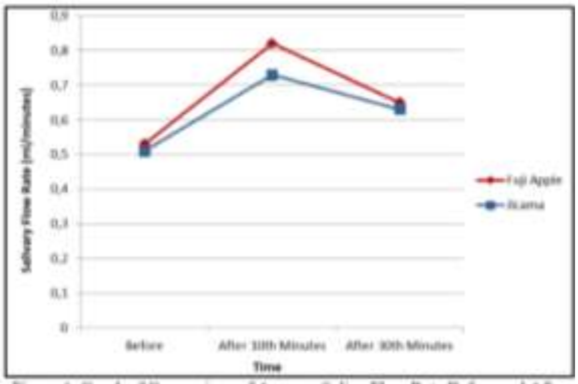

Figure 1. Graph of Comparison of Average Saliva Flow Rate Before and After Chewing Fuji Apple and Jicama

The results of the Wilcoxon test stated that there was a significant change in salivary flow rate before and in the 10th minute after chewing Fuji Apples (p=0,000; mean diff = -0,30), in the 10th and 30th minutes after chewing Fuji Apples (p=0,005; mean diff = 0,18), as well as before and at 30 minutes after chewing Fuji Apples (p=0,006; mean diff = -0,12) (Table 4).

In the Jicama group, there was a significant change in salivary flow before and at the 10th minute after chewing the Jicama (p=0,000; mean diff = -0,22), at the 10th and 30th minutes after chewing the Jicama (p= 0,020; mean diff = 0,10), as well as before and at 30 minutes after chewing Jicama (p=0,019; mean diff = -0,12) (Table 4).

Table 4. Differences in Saliva Flow Rate Before, at 10th and 30th Minutes After Chewing Fuji Apples and Jicama

Groups	N	Saliva Flow Rate					
		Before – 10th minutes		10th minutes – 30th minutes		Before – 30th minutes	
		Mean diff	p-value	Mean diff	p-value	Mean diff	p-value
Fuji Apples	18	-0,30	0,000*	0,18	0,005*	-0,12	0,006*
Jicama	18	-0,22	0,000*	0,10	0,020*	-0,12	0,019*

Notes: Wilcoxon test
*Significant (p<0,05)

The results of the Mann-Whitney test stated that chewing Fuji Apples and Jicama had the same ability to increase salivary flow rate (p=0,625; p>0,05), so there was no significant difference in the two treatments. If seen from the mean of the two treatments, Fuji Apple (0,67) is

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better than Jicama (0,63) in increasing the salivary flow rate (Table 5).

Table 5. Differences of Mean Total in Saliva Flow Rate Before, at 10th and 30th Minutes After Chewing Fuji Apples and Jicama

Chewing	Mean (ml/minutes)	p
Apel Fuji	0,67	0,625
Bengkuang	0,63	

Notes: Mann-Whitney Test

The results of structural characterization of Fuji Apples using SEM at magnetic 500x, 1000x, and 1500x showed wavy surfaces or gradations of shapes (Figure 2).

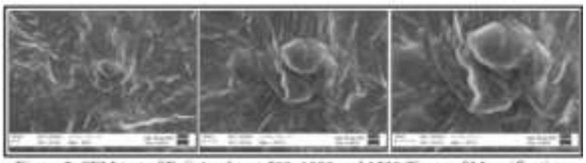

Figure 2. SEM test of Fuji Apples at 500, 1000 and 1500 Times of Magnification

The results of the morphological structure of starch grains and fiber content of Jicama from SEM tests at magnetic 500, 1000, 1500, 2500, and 5000 times of magnification show the presence of:

1. Coagulated starch granules (Ag) (Figure 3),
2. Round starch granules (RS) (Figure 4),
3. Angled polygonal starch grains (PS) (Fig. 4 at 2500 and 5000 times of magnification), and
4. Parenchyma cells (PC) and some empty vacuoles (Figure 4 at 5000 times of magnification).

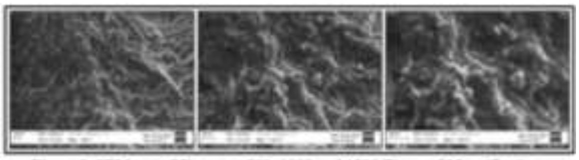

Figure 3. SEM test of Jicama at 500, 1000 and 1500 Times of Magnification

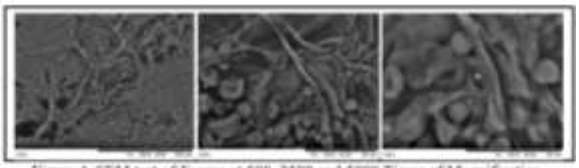

Figure 4. SEM test of Jicama at 500, 2500 and 5000 Times of Magnification

The results of characterization using EDX at 100µm magnetic noted that the elements contained in Fuji Apple with the five highest chemical compositions are O (oxygen) 70,99%, In (indium) 18,59%, K (potassium) 9,56%, Al (aluminum) 0,51%, and Mg (magnesium) 0,36% (on a scale of 1:1:1 = 1x1x1 cm fruit pieces) (Table 6).

The results of characterization using EDX at 100µm magnetic note that the elements contained in Jicama with the seven highest chemical compositions are O (oxygen) 73,44%, In (indium) 13,98%, K (potassium) 6,00%, P (phosphorus) 2,23%, Mg (magnesium) 2,14%, Si (silicon) 1,22%, and S (sulfur) 0,98% (on a scale of 1:1:1 = pieces of fruit 1x1x1 cm) (Table 6).

The results of the characterization using EDX show that the oxygen element contained in Fuji Apple is 70,99% and Jicama is 73,44%. The pores on Jicama appear larger than Fuji Apples due to the higher oxygen content contained in Jicama (Table 6).

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Table 6. EDX test of Fuji Apples and Jicama

Name of Element	Atom No.	Series	C norm		C Error	
			Fuji Apples	Jicama	Fuji Apples	Jicama
O (oxygen)	8	K	70,99	73,44	-	-
In (indium)	49	L	18,59	13,98	-	-
K (kalium)	19	K	9,56	6,00	-	-
Al (aluminium)	13	K	0,51	-	-	-
Mg (magnesium)	12	K	0,36	2,14	-	-
P (fosfor)	15	K	-	2,23	-	-
Si (silicon)	14	K	-	1,22	-	-
S (sulfur)	16	K	-	0,98	-	-
C (carbon)	6	K	0,00	0,00	-	-
Total			100,00	100,00	-	-

Notes :
C norm : Elements value at samples
C Error : Error elements value at samples

In this study, Fuji Apple and Jicama samples were cut to lengths ranging from 1x1,2x0,3 cm. Samples were given a solution of hematoxylin and eosin (H&E staining) to determine the fiber structure of Fuji Apple and Jicama. Histological (microscopic) test results are similar to those of the SEM test, Fuji Apples have wavy gradations. The cells in a Fuji Apple section are arranged in a regular honeycomb pattern (pentagon and hexagon) (Figure 5). Jicama has gradations of shapes that are neatly arranged, very dense, and like a square (Figure 6).

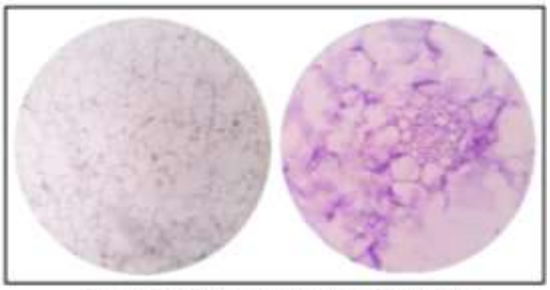

Figure 5. Histology test (microscopic) of Fuji Apples

Figure 6. Histology test (microscopic) of Jicama

IV. DISCUSSION

In Table 2 it can be seen that the average salivary flow rate before, at the 10^{th} and 30^{th} minutes after chewing Fuji Apples was 0,53 ± 0,30 ml/minute, 0,82 ± 0,49 ml/minute, and 0,65 ± 0,30 ml/min. The salivary flow rate increased in the 10th minute and decreased in the 30^{th} minute after chewing Fuji Apples.

Saliva production in the oral cavity is divided into two types, namely unstimulated saliva and stimulated saliva. The stimulated salivary reflex occurs when the chemoreceptors and receptors in the oral cavity respond to the presence of food. Receptors that are activated when chewing food are gustatory receptors and mechanoreceptors. There are four tastes that trigger salivary secretion through gustatory receptors, namely sweet, bitter, sour, and salty. Sour and salty taste is a strong stimulus in triggering salivary secretion. Gustatory receptors are found on the papillae of the tongue in the form of taste buds, while mechanoreceptors in the periodontal ligament and gingival mucosa are activated through the movement of the teeth during mastication. Apples contain malic acid, that is, a dicarboxylic acid which gives Apples a sour and bitter taste that helps keep teeth clean.[13,14]

Most (90%) of saliva is produced from stimuli in the form of tasting and chewing food.

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93% of saliva is secreted by the major salivary glands and the remaining 7% is secreted by the minor salivary glands. Efforts to improve dental and oral health can be done by controlling plaque, including mechanically, chemically and naturally. Plaque control which is generally carried out daily is by mechanical means through tooth brushing and flossing as well as chemically through antiseptic mouthwash. The limitations of brushing your teeth at certain times and rinsing with an antiseptic solution make natural plaque control a companion to mechanical plaque control. Plaque control naturally can be done by chewing fresh and fibrous food.[5,15,16]

This research was in line with the research of Aprillia et al. i.e. carried out before and after chewing the Royal Gala Apples experienced an increase in good criteria by (57,6%) from previously none to 19 people, moderate criteria decreased 21,2% from 20 people (60,6%) to 13 people (39,4%) and bad criteria decreased by 36,4% from 13 people (39,4%) to 1 person (3%). The results of research by Hanifah Huda et al. also stated that the average plaque index before chewing Fuji Apples was 2,75 ± 0,78 and after chewing Fuji Apples decreased to 1,06 ± 0,59.[8,12]

In Table 3 it can be seen that the average salivary flow rate before, at the 10th and 30th minute after chewing Jicama was 0,51 ± 0,27 ml/minute, 0,73 ± 0,35 ml/minute, and 0,63 ± 0,32 ml/minute. The salivary flow rate increased in the 10^{th} minute and decreased in the 30^{th} minute after chewing Jicama.

Research by Ni Nyoman Ayu Noviyanti et al. in line with this study that the mean plaque index before chewing Jicama was 1,310 ± 0,706 and after chewing Jicama was 0,617 ± 0,354.[5]

It is assumed that chewing Fuji Apple and Jicama can stimulate salivary secretion in the oral cavity so that the lower the viscosity of the saliva. Saliva has a buffering ability that can keep the salivary pH down or up and as self-cleansing thereby reducing the plaque index. If the salivary flow rate increases, the salivary pH will also increase (alkaline). When the salivary pH in the oral cavity increases (alkaline), the caries process can be prevented.

In table 5 it can be seen from the Mann-Whitney test that there was no significant difference between chewing Fuji Apples and Jicama, that is, its have the same ability to increase the salivary flow rate. If we look at the mean of the two treatments, chewing Fuji Apples (0,67) is better than Jicama (0,63) in increasing the salivary flow rate.

Salivary flow rate is influenced by bite size, duration of chewing activity, and oro-sensory exposure time stimulation. If the bite size is small and the chewing activity is more, it will cause longer oro-sensory exposure time and modulate the control. Fuji Apples and Jicama are fibrous fruits and contain a lot of water, so they have good self-cleaning power and result in a decrease in the plaque index. The texture of Jicama is rough and the taste is not sweet enough, the Fuji Apple which is chewed with the peel and have a sour and sweet taste; will increase salivary secretion.[10,17,18]

In this study, structural characterization of Fuji Apples from SEM tests at magnetic 500x, 1000x, and 1500x showed wavy surfaces or gradations of shapes (Figure 2).

The research results of Nicola Negrini et al. performed scanning electron microscopy analysis on samples of decellularized and controlled Golden Delicious Apples to investigate their structure at the microscale. Golden Delicious Apples exhibit homogeneous porosity, with round pores characterized by an average diameter of 420 ± 33 μm.[19]

The difference between this study and Nicola Negrini's is the procedure performed on the sample. The tissue morphology of the Apples was investigated before and after decellularization to observe the possible effects of the samples. All tissues in the sample lost pigmentation after decellularization treatment.[19]

The structural characterization of Jicama at magnetic 500x, 1000x, 1500x, 2500x and 5000x showed the presence of:

1. Coagulated starch granules (Ag) (Figure 3),
2. Round starch granules (RS) (Figure 4),
3. Angled polygonal starch grains (PS) (Fig. 4 at 2500 and 5000 times of magnification), and
4. Parenchyma cells (PC) and some empty vacuoles (Figure 4 at 500 times magnification).

The results of this study have many similarities with the results of research by Lucia Gonzalez-Lemus et al., the morphological structure of starch granules and fiber content Bengkuang has round starch granules (RS); polygonal starch granules (PS); agglomerate starch granules (Ag); parenchyma cell wall residue (PCR). Jicama is formed with unfused compound starch granules (CS), such as rice. SEM of fresh Jicama shows parenchyma cells (PC), native compound starch granules (CS) and some empty vacuoles.[20]

The results of the characterization using EDX showed that the oxygen element contained in Fuji Apple was 70,99% and Jicama was 73,44%. The pores on Jicama appear larger than those of

Fuji Apples due to the higher oxygen content contained in Jicama.

The larger fruit of the same cultivar has a higher proportion of air than the smaller fruit. Therefore, the characterization of the intercellular air spaces and their distribution based on microstructural properties is related to the physiology of the fruit. In this study, the size of Jicama is larger than Fuji Apples, so according to the explanation above, fruit with greater porosity is proven to have a greater rate of internal gas diffusion.[21]

The SEM test and histology (microscopic) are assumed to have similarities because the SEM test produces 3-dimensional images while histology (microscopic) produces 2-dimensional images. Histological (microscopic) test results are similar to those of the SEM test, Fuji Apples have wavy gradations. The cells in a Fuji Apple section are arranged in a regular honeycomb pattern (pentagon and hexagon) (Figure 5). This result is in line with the research of Yaguang Luo et al. that the cells in fresh Apple slices were examined by SEM which showed that they were arranged in an orderly manner like a honeycomb pattern. At higher magnification, the cell walls of freshly cut Apples appear wavy.[22]

The results of histological (microscopic) tests on Jicama have gradations of shapes that are neatly arranged, very dense, and like a square (Figure 6). Jicama is assumed to contain more fiber and water content than Fuji Apples, in line with the EDX test that Jicama contains more compounds (Table 6).

Research by Gurmail Edahar and Joseph Jen, Jicama was cut 3 mm thick and then evacuated under continuous vacuum at 201 mm Hg for 2 hours. Samples were dehydrated by storing in 70% alcohol for 2 hours, followed by immersion in 80%, 90%, and 95% alcohol for 1 hour, respectively. Samples were photographed with a research microscope (tungsten-halogen illuminator). The patterns on Jicama are assumed to have different variations of shapes such as irregular squares, pentagons, hexagons, and heptagons.[23]

V. CONCLUSION

1. The average salivary flow rate before, at the 10th minute, and at the 30th minute after chewing Fuji Apples was 0,53 ± 0,30 ml/minute, 0,82 ± 0,49 ml/minute, and 0,65 ± 0,30 ml/min. There was a significant change in salivary flow rate before – at 10 minutes (p=0,000), at 10 – 30 minutes (p=0,005), and before – 30 minutes after chewing Fuji Apple (p=0,006) .
2. The average salivary flow rate before, at the 10th minute, and at the 30th minute after chewing Jicama were 0,51 ± 0,27 ml/minute, 0,73 ± 0,35 ml/minute, and 0,63 ± 0,32 ml/min. There was a significant change in salivary flow rate before - at 10 minutes (p = 0,000), at 10 - 30 minutes (p = 0,020), and before - 30 minutes after chewing Jicama (p = 0,019).
3. There was no significant difference between the two treatments (p=0,625) so that Fuji Apple and Jicama had the same ability to increase salivary flow rate. If seen from the average of the two, Fuji Apple (0,67) was better than Jicama (0,63) in increasing the salivary flow rate. The results of the morphological characterization of the structure of Fuji Apple using SEM resemble a wavy surface, while Jicama has various kinds of starch granules, parenchyma cells, and several empty vacuoles.
4. The characterization results using EDX showed that the oxygen element contained in Fuji Apples was 70,99% and Jicama was 73,44% causing Jicama pores to appear larger than Fuji Apples.
5. Histological (microscopic) test results. Fuji Apples are arranged in an orderly manner like a honeycomb pattern, while Jicama has gradations of shapes that are neatly arranged, very dense, and square-like.

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