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The Effect of Using Natural Yeast (Sourdough Starter) on Organoleptic Quality, Chemical Quality, Functional Quality, Energy Value, and Glycemic Index of White Bread Substitution for Purple Sweet Potato Puree (Ipomoea Batatas L) for Type 2 Diabetes Mellitus Sufferers

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Abstract: *Type 2 Diabetes Meitus (T2DM) is a chronic disease with the prevalence of sufferers that continues to increase every year and can cause complications and even death. T2DM management can be done through nutritional therapy, education, physical activity, and pharmacology. One form of nutritional therapy is to do 3J, namely the right schedule, type, and amount in DM patients. The right type can be done by choosing foods with a low to moderate glycemic index so that people with diabetes can control their blood glucose levels. The purpose of this study was to determine and analyze the effect of using natural yeast (sourdough starter) on chemical quality (moisture content, ash content, and carbohydrates), functional quality, namely resistant starch fiber, glycemic index, energy value, and organoleptic quality (taste, color, texture, and aroma) in white bread substituted with purple sweet potato for patients with type 2 diabetes. This type of research was experimental Completely Randomized Design (CRD) using 3 levels of treatment with natural yeast percentages of 30%, 40%, and 50% with the addition of purple sweet potato (Ipomoea Batatas L.) as much as 40%. The results showed that natural yeast (sourdough starter) had a significant effect ($p<0.05$) on chemical and functional quality, namely water content, ash content, carbohydrates, and resistant starch as well as on organoleptic quality of taste, color, and aroma. Chemical quality, namely carbohydrate content meets the 2015 PERKENI dietary standards (45 – 65%) and the functional quality of resistant crate fiber also meets the 2015 PERKENI dietary standards (20 – 35 grams/day). The water content and ash content have met SNI 01-3840-1995 for white bread standards. The best treatment has a glycemic index of 72 was at the level of treatment P2 with the highest yield value (Nh) 0.81.*

Keywords: Type 2 Diabetes Meitus, Bread, Natural yeast, Glycemic index

INTRODUCTION

International Diabetes Federation (IDF) 2019 report _ that sufferer diabetes mellitus (which furthermore called DM) at all over world increase of 425 million population (2017) to 463 million population (2019), and predicted sufferer DM will Keep going increase to 578 million in in 2030 to 700 million in 2045. More _ carry on IDF 2019 report _ that as many as 4.2 million resident in all over world die consequence suffer DM, so DM become Wrong One of 10 diseases reason death in world. Centers for Disease Controls (CDC) 2020 report _ that DM is disease Which can trigger complications like disease heart, disease kidneys, and strokes. In 2018 there were 7.8 million House Sick in America Union handle case DM with complications disease heart, 438 thousand among them is disease heart ischemic. More carry on CDC 2020 report _ by 37% of sufferers DM in America Union experience complications fail kidney chronicle. Sufferer DM Also can experience retinopathy diabetes or blindness, World Health Organization (WHO)

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2020 report _ as many as 2.6% of sufferers DM in all over world experience blindness, therefore DM is disease Which experience enhancement every year and cause various complications until death. Research Health Basis (Riskesdas) 2018 report happen enhancement DM from in 2013 it was 6.9% to 8.5% in 2018, for Province Java East is at in ranking 5th with prevalence 2.8%. BPS City Malang (2019) reported that DM is ranking 3rd out of 10 diseases with case the most namely 9,214 Souls, which It means DM is problem Serious Which must quick resolved.

Management DM consists of 4 main pillars, namely therapy nutrition medical, activity physical, educational, and therapy pharmacology. Effort therapy nutrition medical Which can done For overcome disease DM Wrong the only one with arrangement eating or dieting. The DM diet can be carried out using the 3J principle or the right schedule, the right type and the right amount, where the application of these principles will have an effect on reducing glucose levels in the blood. The accuracy of the schedule in question is that DM sufferers must eat food at the time scheduled by a nutritionist because this schedule can help blood sugar to become stable. Apart from that, schedule arrangements need to be made so that sufferers can divide their meal times into small but frequent portions so that carbohydrates are easier to digest. and absorbed. Type accuracy is the selection of food ingredients consumed by DM sufferers. DM sufferers should consume complex carbohydrate sources, food sources with a low glycemic index, and the right type of food processing. The accuracy of the amount is that DM sufferers need to comply with the recommended intake that has been set, namely carbohydrate intake of 45 – 65%, protein 10 – 20%, fat 20 – 25%, sodium <2300 mg/day, and fiber 20 – 35 g/day (PERKENI, 2015). The results of research by Himmah et al (2020) show that DM sufferers who have a balanced diet and comply with 3J will have a decrease in blood glucose levels of 52.05 mg/dl, while DM sufferers who do not comply with 3J will have a lower decrease in blood glucose levels. namely 5.12 mg/dl. DM sufferers often do not comply with the 3J accuracy, referring to research by Santi and Septiani (2021) which states that 72.1% of respondents had poor blood glucose levels due to the amount of food that did not comply with the recommendations, then 73% of respondents did not comply with the appropriate type of food, and as many as 71.9% of respondents did not adhere to an accurate eating schedule. From several research results, it is stated that if DM sufferers do not comply with the 3J (Schedule, type and amount), their blood glucose levels will worsen or be unstable.

Purple sweet potato (Ipomoea batatas L.) is one of the local non-rice food sources that can be consumed by DM sufferers. Sweet potato sweet potato purple (Ipomoea batatas L.) is type tubers local Which own index glycemic Which low until medium. According to results study Sutanto (2015), value average index glycemic on rice is 72.89 which classified index glycemic high, meanwhile mark average index glycemic sweet potato sweet potato purple including in category currently namely 62.56. According to results study Putri (2017), on making brownies steam with substitution sweet potato sweet potato own index glycemic with category low (53.76%). Consuming purple sweet potatoes can also help increase consumption of local non-rice food and support the 4 pillars of balanced nutrition program, the first pillar is food diversity. The Ministry of Agriculture's Food Security Agency reported in 2021 that the grain group still dominates staple food consumption patterns in Indonesia compared to the tuber group. The energy contribution from the grain group is 22 kcal/cap/day, while the energy contribution from the tuber group is only 2 kcal/cap/day. The development of food consumption in Indonesia is still uneven because people are more accustomed to consuming rice made from rice and products made from wheat such as noodles and bread. Rice consumption in 2020 was 94 Kg/cap/year and wheat consumption was 17.1 Kg/cap/year, while consumption of tubers, especially sweet potatoes, was only 3.2 Kg/cap/year. Therefore, purple sweet potato is an alternative source of local non-rice carbohydrates that can be consumed by DM sufferers.

Making bread bid can be done with a number of method, apart from using instant yeast, you can also make bread use yeast experience or often called use Sourdough starter. Sourdough or yeast experience is results from fermentation yeast wild (wild yeast) and Bacteria Sour Lactate (BAL)

which can made replacement yeast instant (baker's yeast). Yeast experience the Already used before yeast instant found And Already general used in Europe For make bread because can increase quality taste and texture (Ko, 2012). Sourdough bread known as bread Which Good For health compared to with bread Which use yeast instant, according to results study Maioli, et al (2008), Sourdough bread own index glycemic Which more low from on bread with yeast instant. Study the done with give Sourdough bread to 15 people Healthy And compared to with bread Which use it yeast instant results is Sourdough bread can lower response sugar blood with mark index glycemic 52.7 whereas bread with yeast instant own mark index glycemic 72 (Maioli et al, 2008). Matter the happen Because exists fermentation between yeast wild and bacteria sour lactate will increase mark nutrition bread. All bread Which fermented with Lactobacilli sp. will own resistant starch content or Resistance Starch (RS) which tall compared to with bread with yeast instant because process fermentation Which long time. Content RS Which tall the will increase sensitivity insulin Because RS is starch Which No Can digested but fermented in intestines small so that produce sour fat chain short (SCFA) which can stabilize sugar blood.

Research on making white bread development aims to determine the chemical quality, functional quality, organoleptic quality, energy value, glycemic index of bread, and the best level of treatment so that it can be used as a snack for people with type 2 DM.

METHODS

This research is experimental research with design Design Random Complete (RAL). The independent variables of this research were the percentage of sourdough starter and purple sweet potato puree at each treatment level. Data collection on chemical quality and energy value is carried out in the Chemical Laboratory Airlangga University Surabaya, product processing and organoleptic quality data collection is carried out in the laboratory Knowledge Technology Food (ITP) Department Nutrition Polytechnic Health Ministry of Health Malang, and data collection on respondents' blood glucose levels was carried out in the laboratory Knowledge Technology Food (ITP) Department Nutrition Polytechnic Health Ministry of Health Poor.

Processing of white bread development is carried out in 3 stages treatment in the form of a proportion of natural yeast / sourdough with 2 repetitions for each level treatment. Level treatment P 1 is bread bid use sourdough starter concentration 30%, treatment level P 2 using sourdough starter concentration 40%, and treatment level P 3 sourdough starter 50% concentration with reference results study Son (2018). Puree sweet potato sweet potato purple Which used 40 % use standard recipes results study Krisnawati and Indrawati (2014) who mention that addition puree sweet potato sweet potato purple as many as 40% have results organoleptic best. Natural yeast or sourdough starter is prepared by mixing 1:1 flour and water then fermented for 24 hours and feeding will be carried out by taking the starter that has been fermented for 24 hours by taking the starter that has been fermented for the previous 24 hours and then mixing it with water and flour in a ratio of 1:1:1 and fermented again for 24 hours, this process is carried out for 7 days. The formulation of ingredients for processing white bread development is presented in Table 1.

The proximate test is carried out as a basis for the product including carbohydrate content using different results from the reduction of protein, fat, ash and water tests. Protein content uses the micro kjedal method, fat content uses the Soxhlet method, while water, ash and resistant starch fiber content uses the gravimetric method.

The organoleptic quality test was carried out using a hedonic scale test by assessing the panelists' preferences for the development bread product. Testing includes taste, aroma, texture and color parameters. The assessment was carried out by 25 moderately trained panelists who had knowledge of organoleptic tests. Panelists were asked to fill out a questionnaire with a rating scale score of 1 to 4 with measurement results from very dislike to very like.

The glycemic index test uses the principle of glucose intake which is absorbed after consumption for two hours. The glycemic index value is the result of calculating the percentage of

area under the curve or Incremental Area Under Curve (IAUC) of the blood glucose response due to consumption of test foods and reference (standard) foods. Testing was carried out on five respondents with the criteria of healthy individuals, not smoking, aged 18 - 25 years, not suffering from DM, and not own history DM in closest family one generation above (parents and siblings). Respondents were given food whose glycemic index would be calculated after fasting for at least 10 hours (except mineral water). Within two hours after administering the tested food (white bread) containing 50 grams of carbohydrates, blood samples will be taken using the finger-prick capillary blood samples method, taken every 15 minutes, 4 times (0, 15, 30, 45) and 30 minutes. 3 times (60,90,120) using the GCU meter.

Table 1. Formulation of Ingredients for Processing White Bread Development

Material	Trial Unit (g)						Total Ingredients (g)
	X 11	X 12	X 21	X 22	X 31	X 32	
Flour wheat	365	365	395	395	425	425	0
Sweet potato sweet potato purple	305	305	305	305	305	305	100
Milk powder	12	12	12	12	12	12	0
Margarine	23	23	23	23	23	23	100
Sugar sand	30	30	30	30	30	30	
Water	230	230	230	230	230	230	
Salt	9	9	9	9	9	9	

Analysis of the proximate test used one way ANOVA, the organolephic test used Kruskall Wallis, the glycemic index value used IAUAC calculations, and the best treatment level used the effectiveness index value.

RESULTS AND DISCUSSION

The white bread developed in this research used different percentages of natural yeast/ sourdough starter, namely 30%, 40% and 50% and was added with purple sweet potato puree in the same proportion, namely 40%, referring to the standard recipe. results study Krisnawati And Indrawati (2014) who mention that addition puree sweet potato sweet potato purple as many as 40% have results organoleptic best. The development of white bread can be used as a snack for people with type 2 DM.

Making white bread using natural yeast / sourdough starter with the

addition of purple sweet potato puree aims to provide an alternative for DM sufferers if they want to consume bread as a snack by using food ingredients that can control blood glucose levels and are in accordance with SNI 01-3840-1995. The production of white bread developed in this research was adapted to the standard DM diet PERKENI (2015), namely For proportion protein 10-20%, fat maximum 30%, carbohydrates 45%-65%, and fiber 25 – 30 grams/day. A description of the development of white bread can be presented in Table 2.

The proximate test is used to determine the basic data of a product. The average results of the proximate analysis are presented in Table 3. The water, ash, carbohydrate and resistant starch content has a p-value <0.05 so it can be said to have a significant difference.

Table 2. Product Description of White Bread Development

Organo-leptic	Formulation P 1 (Yeast natural / *Sourdough starter 30%*)	P 2 (Yeast natural / *Sourdough starters 40%*)	P 3 (Yeast natural / *Sourdough starter 50%*)
Flavor	Sweet (++) Acid (+)	Sweet (++) Acid (++)	Sweet (+) Acid (+++)
Color	Purple color (+)	Purple color (++)	Purple color (+++)
Texture	Dense, has few cavities, slightly drags when swallowed	Hollow, soft, light, no drag	Has the most cavities, soft, light, does not drag
Aroma	The aroma of sweet potatoes and the aroma of	The aroma of sweet potatoes and the aroma of	The aroma of sweet potatoes and the aroma of

Organo-leptic	Formulation P 1 (Yeast natural / *Sourdough starter 30%*)	P 2 (Yeast natural / *Sourdough starters 40%*)	P 3 (Yeast natural / *Sourdough starter 50%*)
	yeast fermentation are like white bread in general, there is no sour aroma	yeast fermentation are like white bread in general, with a slight sour aroma (+)	yeast fermentation like white bread in general, a sour aroma appears (++)

Information:

- Sign (+) on column flavor show the more Lots sign (+), The taste of the bread increasingly appears sweet and sour
- Sign (+) on column color show the more Lots sign (+), the color of the bread looks more striking
- Sign (+) on column aroma show the more Lots sign (+), the aroma of the bread became increasingly sour

The highest water content of white bread for development was in the P3 treatment, namely 9.76, which is still in accordance with the water content standards according to SNI 01-3840-1995. The increase in water content that occurs in developing white bread can occur due to the addition of the percentage of natural yeast. This is because the higher the percentage of natural yeast, the water content also increases. Natural yeast/ sourdough starter is a mixture of flour and water that is fermented to form lactic acid bacteria, therefore every additional natural yeast used will increase the water content of white bread (Neysen, 2005). The addition of natural yeast to bun products (Chinese Steam Bread) also has an effect on increasing the water content, buns with instant yeast (control) have a water content of 36.5% while buns using 10% natural yeast have a water content of 37%, buns with 20% natural yeast have a water content of 37.8%, buns with 30% natural yeast have a water content of 39%, and buns with 40% natural yeast have a water content of 40% (Wang et al., 2018). The highest ash content of white bread for development was in the P3 treatment, namely 2.9, which is still in accordance with the water content standards according to SNI 01-3840-1995.

Table 3. Average Test Results for Proximate Content, Energy Value And Resistant Starch

Chemical components (%)	Type of treatment			Sig (0.05)
	P1	P2	P3	
Water	9.41	9.67	9.76	0.0001
Ash	2.81	2.89	2.9	0.0019
Carbohydrate	67.46	66.47	66.3	0.0000
Resistant starch	2.73	2.98	3.26	0.0000
Energy value	414.9	414.82	414.99	0..520

Carbohydrate levels are calculated using the by difference method, so carbohydrate content is influenced by other nutritional components. The increase in carbohydrate content is influenced by the water content, ash content, protein and fat of the developed white bread. Based on Table 4, the average carbohydrate content in white bread is around 6.31 – 6.42% of the total energy intake for one snack (210 Kcal). This meets the carbohydrate requirements for type 2 DM sufferers according to PERKENI (2015), namely the total energy intake for one snack at one meal is 10%.

The energy value of developing white bread at each level of treatment is relatively the same, so it can be said that the difference in the percentage of natural yeast / sourdough starter does not have an insignificant effect on the energy value. The energy value of white bread development has met the requirements for the proportion of snacks in one meal, namely 10% of the total energy of 2100 Kcal, 50 grams of bread a day can contribute an energy intake of 207.45 Kcal.

Table 4. Average Carbohydrate Content from Total Energy of White Bread Development at Each Treatment Level

Level of Treatment (Percentage of natural yeast/ *sourdough starter)*	Contribution of Carbohydrates to Energy of White Bread (%)
P_1 (Yeast natural/ *Sourdough starter 30%*)	6.42

Level of Treatment (Percentage of natural yeast/ *sourdough starter)*	Contribution of Carbohydrates to Energy of White Bread (%)
P_2 (Yeast natural/ *Sourdough starters 40%*)	6.33
P_3 (Yeast natural/ *Sourdough starter 50%*)	6.31

Resistant starch fiber content in developed white bread ranges from 2.73 – 3.26 grams of total fiber intake per 100 grams of bread. This meets the dietary fiber requirements for type 2 DM sufferers according to PERKENI (2015), namely a total daily fiber intake of 20 - 35 grams. The presence of Lactic Acid Bacteria can increase the content of resistant starch which can become good bacteria in the intestines and produce short chain fatty acids which can increase feelings of fullness and reduce blood sugar levels (Kimbell, 2018).

The glycemic index value of white bread development was calculated using the IAUAC formula from the results of fasting blood glucose tests of respondents who had signed an informed consent form. The criteria for respondents to the glucose test are individuals who do not suffer from DM and do not have a history of DM in their immediate family within one generation (parents and siblings). The next criteria are that the respondent has a normal BMI (18.5 - 25 kg / m2), of the five respondents all have a normal BMI with an average of 24 Kg/m2, and have a normal fasting blood glucose value of <100 mg/dl as presented in Table 5

Respondents were given development white bread as a test food and commercial white bread as a reference food with each bread containing 50 grams of carbohydrates. Blood glucose levels were measured for two hours on respondents who had fasted for at least 10 hours using the finger-prick capillary blood method using an Easy Touch glucometer. GCU to obtain the respondent's blood glucose response to the food being tested. The blood glucose response of respondents showed that there were differences in the increase in blood glucose after giving food. The peak blood glucose level after administration of food occurred at 60 minutes for all foods and then decreased at 90 and 120 minutes with the highest value being 158.4 mg/dl for consumption of the reference food, namely white bread, and the lowest value was 110. 4 mg/dl on consumption of the test food ingredient which is bread with the formulation yeast natural / Sourdough starter 50%.

Table 5. Respondent Identity

Respondent Code	Age (Year)	BB (kg)	TB (cm)	BMI (Kg/ m^2)	Fasting Blood Glucose (mg/dl)
01	22	60	158	24	83
02	21	61	158	24	90
03	22	60	156	25	76
04	21	57	156	23	72
05	21	58	155	24	91
Average	**21.4**	**59.2**	**156.6**	**24**	**82.4**

Based on the curve in Figure 6, it can be seen that the increase in glucose that occurred in respondents after consuming the reference food was higher than the test food, then from the three floating breads it can be seen that the bread with the addition of natural yeast / sourdough starter did not have a significant difference so it can be said that all bread with natural yeast has a low glycemic index value. A sudden increase in high blood glucose after consuming a food can cause insulin secretion in the pancreatic cells to increase and will cause fatigue in the pancreas so that the pancreatic cells cannot meet insulin needs and blood glucose will remain high, this condition of continuously high blood glucose will cause type 2 DM (Willet et al, 2002).

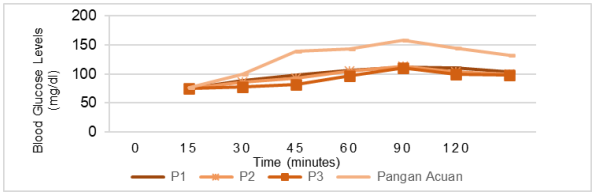

Figure 1. Blood Glucose Response Curve of Respondents to Test Food and Reference Food

The organoleptic qualities of the developed white bread tested were taste, color, texture and aroma as presented in Table 6. The research panelists were 25 somewhat trained

people who had signed an informed consent form. The bread taste that the panelists liked most was the P1 treatment level with a natural yeast percentage of 30% with an average value of 2.36 – 3.68. The difference in yeast percentage had a significantly different effect on the level of taste preference. According to research by Putra (2018), panelists preferred the taste of sweet bread with 10% natural yeast with a preference value of 3.95, while bread using 50% natural yeast was less preferred with a preference value of 1.45. The natural yeast used in developing white bread is processed by fermenting water and flour for several days, this causes the growth of Lactic Acid Bacteria (LAB) which can give the bread a sour taste.

Table 6. Average Organoleptic Quality Test Results

Type of treatment	Organoleptic Quality			
	Flavor	Color	Texture	Aroma
P1	3.68 [a]	2.76 [a]	3 [a]	3.28 [a]
P2	2.92 [b]	3.28 [a]	3.16 [a]	3.12 [a]
P3	2.36 [c]	3.28 [b]	2.68 [a]	2.4 [b]

Different letters indicate significant differences (α= 0.05)

The bread color that the panelists liked most was the P2 treatment level with a natural yeast percentage of 40% with an average value of 2.76 – 3.28. The panelists' level of preference increased along with the increasing content of natural yeast/ sourdough starter used. The content of natural yeast/ sourdough starter in white bread development influences the color of the bread. This is in line with the results of research by Putra (2018) which states that adding the percentage of natural yeast / sourdough starter has a significantly different effect on the color preferences of sweet bread. The higher the percentage of yeast used, the more the panelists' favorite value increases, namely ranging from 3.6 to 4.35. The content of lactic acid bacteria in natural yeast can increase the brightness of the color of white bread so that the color of the bread is more attractive (Kimbell, 2018).

The bread texture that the panelists liked most was the P2 treatment level with a natural yeast percentage of 40% with an average value of 2.68 – 3.16. White bread that uses natural yeast can provide a soft texture, bread with the addition of 30% natural yeast has a softer texture compared to the addition of 20% yeast (Hadaegh et al, 2017), this is due to the fermentation process involving Lactic Acid Bacteria (LAB). which can activate proteolytic enzymes in wheat flour which can dissolve the gluten content so that it can reduce the level of hardness of bread (Clarke, 2002). The texture of bread with natural yeast depends on the CO 2 content during the fermentation process. The more CO 2 contained in the yeast, the more fluffy the bread will be and will have a lighter texture and will have more pores.

The bread aroma that the panelists liked most was the P1 treatment level with a natural yeast percentage of 30% with an average value of 2.4 – 3.28. Putra's research results (2018) stated that panelists preferred the aroma of sweet bread with 10% natural yeast with a liking value of 3.75, while bread using 50% natural yeast was less preferred with a liking value of 2.15. The natural yeast used in developing white bread is processed by fermenting water and flour for several days, this causes the growth of Lactic Acid Bacteria (LAB). LAB can cause a sour aroma in white bread which is characteristic of bread that uses natural yeast (Thiele, 2002), the more natural yeast is added, the more sour the aroma will appear.

The results of the analysis to determine the best level of treatment show that the most important variables for developing white bread are the glycemic index, resistant starch and organoleptic taste quality. The glycemic index is a level of food according to its effect on blood glucose levels. Foods with a low glycemic index can increase blood glucose levels slowly (Rimbawan and Siagian, 2004). The white bread formulation was developed using 40% natural yeast/ sourdough starter and the addition of 40% purple sweet potato puree (P2) with bread characteristics as in Table 7.

Table 7. Respondent Identity

Character-istics	White bread	SNI Standard 01-3840-1995	PERKENI Standard 2015 (20%)
Water content (%)	9.67	Maximum 40	-

Character-istics	White bread	SNI Standard 01-3840-1995	PERKENI Standard 2015 (20%)
Ash content (%)	2.89	Maximum 3.0	-
Carbohydrates (g)	66.47	-	47 – 68
Resistant starch (g)	2.98	-	2 – 3.5
Energy Value	414.82	-	420
Glycemic index	71	-	-
Flavor	Sweet with a slight sour taste	-	-
Color	Purple	-	-
Texture	It's soft, soft, and doesn't drag	-	-
Aroma	Typical ıread with little sourness	-	-

CONCLUSIONS

The use of natural yeast/ sourdough starter can affect the quality of taste, aroma and color of white bread. Natural yeast/ sourdough starter can affect the water content, ash content, carbohydrates, resistant starch, and glycemic index of developing white bread. Treatment P2, namely the use of 40% natural yeast with a glycemic index value of 71, is the best treatment level.

For further research, it is possible to improve the organoleptic quality at the P2 treatment level because there is still a sour taste and aroma.

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