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Kampus A Wonokromo : Jl. SMEA No.57 Tlp. 031-8291920, 8284508 Fax. 031-8298582 – Surabaya 60243
Kampus B RSIJemursari : Jl. Jemursari NO.51-57 Tlp. 031-8479070 Fax. 031-8433670 – Surabaya 60237
Website : unusa.ac.id Email: info@unusa.ac.id

SURAT KETERANGAN

Nomor: 425/UNUSA-LPPM/Adm-I/III/2023

Lembaga Penelitian dan Pengabdin Kepada Masyarakat (LPPM) Universitas Nahdlatul Ulama Surabaya menerangkan telah selesai melakukan pemeriksaan duplikasi dengan membandingkan artikel-artikel lain menggunakan perangkat lunak **Turnitin** pada tanggal 17 Desember 2022

Judul	: Analysis of Antioxidant Activity, Vitamin C, and Lactic Acid of Yogurt Made Form Cow and Goat Milk Used Electric Shock and Conventional Methods
Penulis	: Endah Budi Permana Putri, Margareta Amelia Iko Ardania
No. Pemeriksaan	: 2023.03.28.171

Dengan Hasil sebagai Berikut:

Tingkat Kesamaan diseluruh artikel (*Similarity Index*) yaitu 2%

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NEW 2022_Analysis of Antioxidant Activity, Vitamin C, and Lactic Acid of Yogurt Made Form Cow and Goat Milk Used Electric Shock and Conventional Methods

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Submission date: 27-Dec-2022 08:30AM (UTC+0700)
Submission ID: 1986798031
File name: w_and_Goat_Milk_Used_Electric_Shock_and_Conventional_Methods.pdf (233.54K)
Word count: 6207
Character count: 32268

FOODSCITECH
Food Science and Technology Journal

Analysis of Antioxidant Activity, Vitamin C, and Lactic Acid of Yogurt Made Form Cow and Goat Milk Used Electric Shock and Conventional Methods

Endah Budi Permana Putri[1*], Margareta Amelia Iko Ardania[1]

[1]Department of Nutrition, Faculty of Health, Universitas Nahdlatul Ulama Surabaya
Jl. Raya Jemursari No.57. Jemur Wonosari, Kec. Wonocolo, Surabaya City, East Java 60237, Indonesia
Corres Author Email: Endah.budi92@unusa.ac.id

ABSTRACT

Along with raising public awareness about health and increasing yogurt consumption .Fermented dairy products are considered beneficial foods for the health of human beings. One of them is yogurt which is a healthy drink made from milk with fermentation processing. The research aimed to analysis of antioxidant activity, vitamin C, and Lactic Acid of yogurt made from cow and goat milk. This study is a pure experimental study using a completely randomized design research, using 2 groups of samples, namely the sample with the electric shock processing method and the sample with conventional processing with 3 repetitions. The data obtained will be presented in tabular form and will be checked using the One Way Anova test. If there are differences, the test will continue with the Ducan test. Based on the results of the research analysis of antioxidant activity, vitamin C and lactic acid in goat's milk yogurt and cow's milk with differences in processing, namely the electric shock method and the conventional method had a statistically significant difference, namely with a p-value (0.00) where the value was ≤ α (0.05) which means that there is a significant difference in the average value of antioxidant activity, vitamin C and lactic acid in each sample. In this study it can be concluded that there are significant differences in the four samples. The best value in this study was found in goat milk yogurt with the electric shock method and the lowest value was found in conventional cow's milk yogurt in each analysis carried out, namely the analysis of antioxidant activity, levels of Vitamin C and lactic acid.

Keywords: *Antioxidant Activity; Cow Milk Yogurt; Goat Milk Yogurt; PEF*

INTRODUCTION

During a pandemic like today, people are required to have awareness of the importance of quality of life to maintain health. One of the efforts to maintain this is by looking for natural food products including functional food ingredients of plant or animal origin. Milk is a biological fluid produced by mammals to meet all the nutritional needs of their newborn children (Susanti & Hidayat, 2016).

Milk contains carbohydrates (lactose), protein, fat, vitamins, and minerals that the body needs (Safitri & Swarastuti 2011). One of the functional foods made from milk is yogurt, where the content of lactic acid bacteria (LAB) provides a significant therapeutic value during milk fermentation, including highly digestible nutrients. Yogurt made from goat's milk has good nutritional content for health including antioxidant content, and iron levels of 4.4348 mg, higher than cow's milk yogurt which is only 3.6839 mg, meaning that this yogurt is highly recommended for people with anemia (Putri & Anggraini, 2021).

However, Yogurt produced by the thermal method has many negative impacts on health, so alternative materials are needed to replace conventional processing methods.
The process of electric shock or commonly known as *Pulsed Electric Field* (PEF) is a food processing process based on the application of short pulses at high voltage (20-80 kV/cm) to foodstuffs to minimize damage to the nutritional content contained therein caused by the heating process (Veri & Bambang, 2015).

PEF has been shown to inactivate microorganisms and has the potential to replace thermal processing for liquid foods (Qin et al., 1995 *in* Najim Kayanush, J. Aryana, 2012). The studied light PEF treatment significantly improved acid tolerance, exponential growth,

and protease activity of both Lb. acidophilus LA-K and Lb. delbrueckii ssp. bulgaricus LB-12 compared to control. (N. Najim Kayanush J. Aryana, 2012).

PEF has also been shown to affect enzyme inactivation and bioactivities of peptic hydrolysates produced from bovine and porcine hemoglobin (Zain Sanchez-Reinoso et al, 2022). In recent years, many studies have reported on pathogenic activation with PEF, such as the inactivation of Salmonella (Amiali et al. 2007), E. coli (Evrendilek and Zhang 2005). Additionally, PEF has been used in combination with other preservative factors to increase its effectiveness; These preservation factors include ultraviolet (Gachovska et al. 2008), antimicrobial (Mosqueda Melgar et al. 2008), and heat treatment (Sampedro et al. 2009).

A large percentage of milk production requires standardized processing measures. This is supported by the statement of Abdela et al., (2018), that it is necessary to prevent food safety by increasing food availability. Prevention needs to be done, especially during a pandemic like today, we know that one of the preventions of Covid-19 is to fulfill nutritional intake to increase endurance. Checking data in the form of raw materials used and additional ingredients used which can affect the quality of the yogurt.

Lactic acid bacteria (LAB), such as Lactobacillus acidophilus, are important in the fermentation process, which is why they are widely used in the food industry, for their ability to acidify food and preserve it from spores as well as intervene in the texture, taste, and smell of the fermented product. Lactic acid fermentation can be interpreted as a process of hydrolysis of lactose by lactic acid bacteria into pyruvic acid, which later the higher the concentration of lactic acid will cause a decrease in pH. The concentration level of this lactic acid will affect the level of lactic acid in a product (Todar, 2011). Based on the explanation above, it is necessary to conduct research on antioxidant activity, vitamin C, and lactic acid in goat's milk and cow's milk yogurt using electric shock and conventional methods.

METHODS

Material

Materials used in the sample making are goat's milk and cow's milk using electric shock processing methods and goat's milk and cow's milk using conventional processing methods. While the materials used for sample analysis are; Analysis of Antioxidant Activity (TCA 10% solution, TBA 0.02 mM solution, distilled water, 0.1 mm DDPH solution, methanol solution, Butyrate Hydroxyl Toluene (BHT) solution from DPPH) (Herdayanto *et al*., 2015), analysis of Vitamin C levels (dilute sulfuric acid 0.1 M, Aquades, 0.01 N Iodine Solution, Standardized $Na_2S_2O_3$ with KLO_3, Starch Indicator) (James *et al*., 2019), analysis of levels of Lactic Acid (NaOH 0.01N, Indicator of phenolphthalein (pp) 1% route pH 8-10 , NaCl 0.85% sterile) (Amalia, 2011).

Tools

Instruments used in this research are measuring cup, basin, vegetable ladle / stirrer, thermometer, bottle, electric shock pasteurizer, a set of antioxidant activity analyser's, a set of analysis tools for vitamin C levels and a set of analyzers for lactic acid levels.

Research Design

The research design used a *true experimental* research with a *Completely Randomized* Design (RAL) using 2 groups of samples, namely the sample with the electric shock processing method and the sample with conventional processing.

FOODSCITECH, 5 No. 2 December 2022
ISSN 2622-1985 (print) l ISSN 2622-4127 (online)
DOI: http://dx.doi.org/10.25139/fst.vi.4991

Test Parameters

The test parameters in this study were analysis of antioxidant activity using the DPPH method, Vitamin C levels using the iodimetric method, and levels of lactic acid using the titrimetric method. Each analysis was performed three times.

Data Analysis

Statistical analysis using the One Way Anova test with α 0.05 for knows the differences of each sample. Data analysts use SPSS with a confidence level of 95%.

RESULT AND DISCUSSIONS

Antioxidant Activity

Analysis of antioxidant activity in this study was conducted using the DPPH (*1,1-diphenyl-2-pycrilhydrazilmethod*). The data obtained from this study are data presented in numerical or numeric form, as follows:

Table.1 Results of analysis of antioxidant activity using the test *one way anova* on cow's milk yogurt and goat milk with electric shock methods and conventionally.

No	Sample	N	*Mean±SD*	*P-value*
1	Conventional Goat Milk	3	$67.50^{b} \pm 1.571$	
2	Goat Milk Electric Shock	3	$76.08^{c} \pm 2.045$	0.00
3	Conventional Cow Milk	3	$53.74^{a} \pm 1.491$	
4	Cow Milk Electric Shock	3	$66.81^{b} \pm 1.700$	

Note: Different letter notations show significantly different results.

Based on Table.1, there is an average value of antioxidant activity in conventional goat milk yogurt and electric shocks and conventional cow's milk yogurt and electric shocks. In the goat milk yogurt sample with the electric shock method, the mean value of the activity of the antioxidants was the highest, while for the cow's milk sample using the conventional method, the average value of antioxidant activity was the lowest. In the analysis of the test, the *One Way Anova* value of antioxidant activity in conventional and shock goat milk yogurt and conventional and shock goat milk yogurt shows a p value (0.00) where the value is ≤ α (0.05) which means that there is a difference in the mean The mean value of antioxidant activity in each sample is significant. The results of the analysis showed that the highest levels of antioxidant activity were found in goat milk yogurt using the electric shock method at 76.08 mg / 100g, goat milk yogurt using the conventional method at 67.50 mg / 100g, yogurt. cow's milk using the electric shock method of 66.81 mg / 100g and cow's milk yogurt using the conventional method of 53.74 mg / 100g. Meanwhile, if you look at the results of the test *Duncan*, there are the same results as the test *One Way Anova*. In the conventional cow's milk yogurt sample, the lowest value was 53.74 mg / 100g and the highest value was 76.0867 mg / 100gr in the electric shock goat milk yogurt sample.

The results of this analysis are in accordance with Puspita and Susilowati (2020), that the difference in nutritional content, precisely on the antioxidant activity of the sample, is influenced by the type of milk which is the main basic ingredient. The nutritional content of goat milk has a higher nutritional content close to breast milk (ASI) with a smaller fat globule size when compared to the nutritional content of other milks. Goat milk contains caratenoids and flavonoids which function as antioxidant compounds. So that goat's milk is proven to have higher levels of antioxidant activity than other types of milk. This statement is supported

by the research results of Wakhidah., et al. (2017), in their research that distinguishes the levels of cow's milk yogurt with goat's milk yogurt added with red ginger extract. The results obtained from the analysis of higher antioxidant activity were found in goat milk yogurt without the addition of ginger extract by 0.994%, an increase of 7.5% after the addition of ginger extract, whereas in cow's milk it only increased by 3.446%. According to Pratiwi (2020), which explains that the high levels of antioxidant activity in yogurt made from goat's milk are due to the high amount of hydrophoblic and aromatic amino acids contained in it. Both act as free radical inhibitors on the amino acid tyrosine. So that based on the results of the research conducted, it can prove that the antioxidant activity content of goat milk has a higher content.

According to Rijal et al., (2020), in the study sample the group that was given electric shock treatment for 15 seconds at a temperature of 35^0C would increase the antioxidant activity in the sample. Giving electric shock treatment to the sample with a long duration will cause the process of the stimulus mechanism in the sample to be disrupted due to damage to the cell tissue in the sample. The damage that occurs will cause a reduction in the hydroxyl group in the secondary metabolite compounds formed in foodstuffs so that it will reduce the level of antioxidant activity in the sample. In addition, giving a high enough temperature to the sample will cause the dissolution of antioxidant compounds into the water. So that these two factors can cause the cell wall and plasma membrane in the material to be damaged.

A possible event is that it is at this time that the water which becomes the medium for electric shocks and heaters will enter the vaskuola and cell walls, both of which can dissolve antioxidant compounds into the processing fluid. So that this incident makes the resulting compound solution possible to be a factor causing bioactive compounds that contain antioxidant activity to dissolve into water, this event will later greatly affect the final quality of the sample or product produced. If it is concluded that processing with the electric shock method which is carried out using a quadric model will show that the higher the temperature and time of electric shock will be effective in increasing the level of antioxidant activity in the sample. However, at a dead end, if the determination of the related treatment temperature and the duration of the shock given will cause a decrease. So that if it is adjusted to literacy by using a voltage of 5kv for 10-20 seconds with a temperature of 25-45^{o}C, it will produce an optimal product both from its nutritional and organoleptic content.

Based on the results of the analysis of antioxidant activity carried out on samples with conventional processing, it showed that the two samples contained antioxidant activity far below the results of the analysis of the samples using electric shocks. The results showed that the conventional cow's milk sample had the lowest content of 53.74 mg / 100gr. This is in accordance with the results of research stated by Veri and Bambang (2015), that the processing of food ingredients, especially yogurt, which is usually processed by the using the method, *thermal* will experience changes in nutritional content and organoleptic properties due to damage to the material because it is old. or the high temperature in the processing. So that another alternative, namely by using the electric shock method, is appropriate to replace conventional processing methods, where this method can maintain and or even increase the nutritional content of certain chemicals in a product or sample produced.

Vitamin C

Levels in this study was carried out using the Iodimetry method. The data obtained from this study are data that are presented in numerical or numeric form.

FOODSCITECH, 5 No. 2 December 2022
ISSN 2622-1985 (print) l ISSN 2622-4127 (online)
DOI: http://dx.doi.org/10.25139/fst.vi.4991

Based on Table.2, there are mean values for Vitamin C levels in conventional goat milk yogurt and electric shocks and conventional cow's milk yogurt and electric shocks. In the goat milk yogurt sample with the electric shock method, the mean value of Vitamin C was the highest, while for the cow's milk sample using the conventional method, the average value of Vitamin C was the lowest. In the analysis of the test, the *One Way Anova* value of Vitamin C in conventional goat milk yogurt and electric shocks and conventional goat milk yogurt and electric shocks shows a p-value (0.00) where the value is ≤ α (0.05) which means that there is a the difference in the mean value of Vitamin C in each sample was significant. The results of the analysis showed that the highest levels of Vitamin C were found in goat milk yogurt using the electric shock method at 2.36 mg / 100g, goat milk yogurt using the conventional method at 1.77 mg / 100g, cow's milk yogurt using the electric shock method. 1.61 mg / 100g and cow's milk yogurt using conventional methods of 1.26 mg / 100g. Meanwhile, if you look at the results of the test *Duncan*, there are the same results as the test *One Way Anova*. In the conventional cow's milk yogurt sample, the lowest value was 1.2600 mg / 100gr and the highest value was 2.3667 mg / 100gr in the electric shock goat milk yogurt sample.

Table 2. Results analysis of vitamin C levels using the test *one way anova* on yogurt cow's milk and goat's milk with electric shock methods and conventionally.

No	Sample	N	*Mean*±SD	*P-value*
1	Conventional Goat Milk	3	$1.77^{c} \pm 0.075$	
2	Goat Milk Electric Shock	3	$2.36^{d} \pm 0.030$	0.00
3	Conventional Cow Milk	3	$1.26^{a} \pm 0.087$	
4	Cow Milk Electric Shock	3	$1.61^{b} \pm 0.035$	

Note: Different letter notations show significantly different results.

The difference in the results of each sample in this study influenced the differences in basic materials and processing methods. The results show that the sample using the electric shock method has a higher nutritional content than the sample using the conventional method. This is in accordance with the statement of La Chaviya and Ratna (2011), the longer the provision of electric shock treatment on the sample will affect the nutritional and chemical content of food ingredients. But the choice of electric shock treatment method is more appropriate when compared to without using this method. Even though the length of treatment given has changed in the form of a decrease in the content contained in the sample, it is not proportional to the decrease that occurs in the sample without electric shock treatment. In addition to affecting the content of Vitamin C contained in the sample, there is an explanation that states that the longer the treatment given will make the product lose its characteristic physical properties such as; taste, smell of the basic ingredients in the product. In the proof, the electric shock method or commonly known as the *Pulshed Electric Field* (PEF) is more effective in using liquid food ingredients, such as; soups, syrups, eggs, and milk and processed products.

This statement is in accordance with the results of research conducted by Choiron and Yuwono (2018), the higher the temperature used in the processing process will make the Vitamin C levels in the sample have a high risk of damage. Giving treatment with high temperatures on the sample will make the content of Vitamin C contained in it will be oxidized to dehydroascorbic acid and will make further damage by changing dehydroascorbic acid to dicetogulonic acid which does not have the activity of Vitamin C anymore. Whereas in the sample that was given electric shock treatment with a long duration, the vitamin C level in the sample decreased which occurred because of the oxidation of Vitamin C. It can be seen that

the higher the intensity of electric shocks given to the sample will cause an induction of oxidation and reduction reactions that can affect microbial metabolism and chemical composition in the sample. The results of the research conducted on samples of mango juice in this study, the best quality was seen in the mango juice which was given a pasteurization temperature of 65^{o}C with the longest shock duration of 8 minutes.

Based on the results of Vitamin C analysis carried out on samples with conventional processing, it showed that both samples had Vitamin C content far below the results of the sample analysis using electric shocks. The results show that the conventional cow's milk sample has the lowest content of 1.2600 mg / 100gr when compared to other samples. This is in accordance with the existing theory that processing food ingredients, especially yogurt, which is usually processed using the method, *thermal* will experience changes in nutritional content and organoleptic properties due to damage to the material due to old or high temperatures in the processing. So that another alternative, namely by using the electric shock method, is precisely chosen to replace conventional processing methods, where this method can maintain and or even increase the nutritional content of certain chemicals in a product or sample produced (Veri and Bambang, 2015).

The difference in the levels of Vitamin C in the sample is in the type of milk which is the main basic ingredient. The nutritional content of goat's milk has a higher nutritional content of 2.00 mg / 100gr when compared to the nutritional content of other milks. In addition, there are other factors that can cause the nutritional content of a material to change, namely due to the effect of the processing process, the intensity of the temperature given, storage time and other additional materials used (Getanch., *et al.,* 2016). This statement is supported by the results of research by Kusumawati., et al. (2018), Changes or decreases in Vitamin C levels can be caused by a processing process. Vitamin C is a nutrient that is easily damaged by exposure to light, high temperatures and the amount of oxygen due to processing. In addition, Vitamin C is very soluble in water and easily oxidized due to exposure to air from outside. Vitamin C itself is a secondary antioxidant that cannot be produced by the body naturally, which is composed of hydroxyl and arbonyl groups which make the molecules in these nutrients become electron donors which act as co-factors for various enzymatic reactions in plasma. So that from several statements explained that the highest Vitamin C content is in goat's milk and it is very important to pay attention to it in terms of processing to maintain the nutritional content contained there in.

Latic Acid

Analysis Lactic acid analysis in this study was carried out using the titrimetric method. The data obtained from this study are data presented in numerical or numeric form, as follows:

Table.3 Results of the Analysis of Lactic Acid Levels Using theTest *One Way Anova* on Yogurt's Milk and Goat Milk with Electric Shock and Conventional Methods.

No	Sample	N	*Mean*±SD	*P-value*
1	Conventional Goat Milk	3	$1.41^{b} \pm 0.036$	
2	Goat Milk Electric Shock	3	$1.87^{d} \pm 0.055$	0.00
3	Conventional Goat Milk	3	$1.18^{a} \pm 0.041$	
4	Cow Milk Electric Shock	3	$1.73^{c} \pm 0.041$	

Note: Different letter notations show significantly different results.

ISSN 2622-1985 (print) l ISSN 2622-4127 (online)
DOI: http://dx.doi.org/10.25139/fst.vi.4991

Based on Table 3, there are mean values for latic acid levels in conventional goat milk yogurt and electric shocks and conventional cow's milk yogurt and electric shocks. In the electric shock goat milk yogurt sample, the average value of lactic acid was the highest, while for the conventional cow's milk yogurt sample, the average value of lactic acid was the lowest. In the analysis of the test, the *One Way Anova* value of lactic acid in conventional goat milk yogurt and electric shock and conventional goat milk yogurt and electric shock shows a p-value (0.00) where the value is ≤ α (0.05) which means that there is a The difference in the mean value of lactic acid in each sample was significant. The results showed that the highest lactic acid was found in goat milk yogurt using the electric shock method at 1.87%, cow's milk yogurt using the electric shock method at 1.73%, goat milk yogurt using the conventional method at 1.41% and Cow's milk yogurt using conventional methods of 1.18%. Meanwhile, if you look at the results of the test *Duncan*, there are the same results as the test *One Way Anova*. In the conventional cow milk yogurt sample, the lowest value was 1.1867% and the highest value was 1.8767% in the electric shock goat milk yogurt sample.

The ANOVA results showed that the electric shock method was found to have a significant ($p < 0.05$) effect on P value. The highest value in this study was found in goat's milk yogurt used electric shock method because this method can maintain the nutritional content in a product. The similar method, was observed for making yoghurt using electric shock method in previous studies by Lee and Lucey, the results are given shock process to milk will make the competitors in lactic acid bacteria (LAB) decrease, so this will affect LAB in lactic acid production.

Like wise Tia (2015), reported that giving an electric shock treatment to the sample with the accuracy of the duration of giving electric shocks and giving the appropriate temperature will be able to kill unwanted microbes so that it will make the yogurt skin grow optimally.

Based on the results of lactic acid analysis carried out on samples with conventional processing, it showed that both samples had lactic acid content significantly bellow the results of the sample analysis using electric shocks. The results show that the conventional cow's milk sample has the lowest content of 1.1867% when compared to other samples. These results is similar to other study that processing food ingredients, especially yogurt, which is usually processed using the method *thermal* which is carried out> 100^0C, will have experience changes in nutritional content and organoleptic properties due to damage to the material due to time or high temperatures in the processing process. So another alternative by using the electric shock method, precisely chosen to replace conventional processing methods, where this method can maintain and or even increase the nutritional content of certain chemicals in a product or sample produced (Veri and Bambang, 2015). Most of the nutritional content of goat milk is proven to have a higher nutritional content when compared to the nutritional content of other milks.

However, goat's milk has a lower lactose ingredient (4.23%) than cow's milk which has a lactose ingredient (6.2%).The lower the levels of lactose in milk will affect the amount of lactic acid levels in a fermentation product. The amount of nutrient content in an ingredient is very important to maintain in order to provide significant benefits, because a nutrient content in food ingredients will change if it is wrong in processing such as; temperature intensity, storage time and other additives used. This observation has been reported in another study, Dewanti., et al (2016), reported that the processing of yogurt used milk as a basic ingredient really needs to be considered in the processing process. This is because the supporting ingredients for yogurt in the form of bacteria have different characteristics. In accordance with this research process or treatment given on the same sample by using Streptococcus

*thermophilusd.*an *Lactobacillus* bulgaricus. The two bacteria have the same characteristics, classified as positive salt, this type of bacteria has an optimal growth temperature around of 45^0C. Achieving this temperature will make the bacteria in yogurt able to live both in an *aerobic homofermentative* and *aerobic homofermentative state.* The microbes will grow optimally and produce a coagulant (lumpy form of milk) with a smooth, thick texture and has a *flavor* (taste and aroma) according to yogurt standards. if its has a good balance temperature intensity.

CONCLUSION

Summing up, it should be significant differences in four samples. The highest value in this study was found in goat's milk yogurt used electric shock method (76.0867 mg / 100gr) and the lowest value was found in conventional cow's milk yogurt (53.74 mg / 100g). The analysis of the Vitamin C content of the conventional cow milk yogurt sample obtained the lowest value. (1.2600 mg / 100gr) and the highest value was 2.3667 mg / 100gr in the electric shock. the highest value was found used electric shock goat milk yogurt sample (1.8767%), and goat milk yogurt sample and the lactic acid content analysis of conventional cow's milk yogurt samples obtained the lowest value (1.1867 %)

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