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**INDONESIAN FOOD AND NUTRITION
PROGRESS**

Sensory Evaluation of Yogurt-like Set and Yogurt-like Drink Produced by Indigenous Probiotic Strains for Market Test

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Abstract

Lactic acid bacteria have been isolated from several Indonesian indigenous fermented foods and screened for the potential strains as probiotic candidates. The aim of this study was to evaluate sensory properties and respondents' preference of yogurt-like set and yogurt-like drink with various Indonesian indigenous probiotic strains produced by dairy industry. Indigenous probiotics of *Lactobacillus plantarum* MUT-7 and *Lactobacillus plantarum* DAD-13 were used to produce yogurt-like set and yogurt-like drink. Family perception toward yogurt-like drink was performed in Yogyakarta involving 100 family members. The yogurt-like products were also compared to yogurt containing commercial *Lactobacillus bulgaricus* and *Streptococcus thermophilus* or commercial yogurt produced by dairy company. Several sensory evaluation toward sensory properties and panelist's preference were performed in different cities. The result showed that the indigenous probiotic *L. plantarum* DAD-13 and *L. plantarum* MUT-7 were potential to be used as a starter culture for the production of yogurt-like set and yogurt-like drink. The combination of indigenous probiotics and indigenous lactic acid bacteria *S. thermophilus* DAD-11 resulted in better sensory properties of yogurt set compared to combination of *L. bulgaricus* and *S. thermophilus*.

Keywords: Indigenous probiotic; *Lactobacillus plantarum*; *Streptococcus thermophilus*; sensory evaluation; market test.

Introduction

In recent years, functional food has attracted both researchers and industries as consumers become more conscious of the health effect as the additional value to the nutrition of the food. Functional food is defined as foods and/or food components that when it is consumed, it provides a health benefit beyond basic nutrition (IFT Expert Report, -). Addition of probiotics into

fermented food, particularly dairy products, is considered as functional food as several studies showed health effect of consuming probiotics. Yogurt has been known as a common source of probiotics, made from milk fermented using *Staphylococcus bulgaricus* and *Lactobacillus bulgaricus*. Yogurt-like products refer to milk which is fermented using other lactic acid bacteria.

Probiotics by definition are living microorganisms, which, when administered in adequate amount as a dietary addition confer a health benefit on the host (FAO/WHO, 2001, FAO/WHO, 2002). The health benefits of consuming probiotics are mainly due to the ability of the probiotics to support the balance of microbiota in intestine. The potential benefit of probiotics on physical health has been studied widely, thus probiotics are utilized by many industries as a starter culture for fermentation of dairy products. However, many industries still rely on import probiotics strains and at the moment, there is no indigenous probiotic strains have been used for food production in industry-scale to be sold in Indonesian market. On the other side, research related to screening, identification, and exploration on the benefit of indigenous probiotic candidates are increasing.

Isolation of indigenous lactic acid bacteria from various fermented foods and other sources has been done by Indonesian researchers (Antara et al., 2009; Lawalata et al., 2011; Pramono et al., 2008; Rahayu, 2003; Suhartatik et al., 2014). The lactic acid bacteria have been screened for their health benefits, such as probiotics (Rahayu, 2003; Rahayu et al., 2015); β -glucosidase producers (Suhartatik et al., 2014; Djaafar et al., 2013a); ACE inhibitor producer (Wikandari et al., 2012); isoflavone and antioxidant properties (Djaafar et al., 2013b). One of the indigenous lactic acid bacteria isolated from *dadih* – fermented buffalo's milk – named *Lactobacillus plantarum* DAD-13 has been studied for its potency as a probiotic strain (Rahayu et al., 2015). The study showed that *L. plantarum* DAD-13 could prevent the growth of pathogenic *E. coli* which causes diarrhea, such as *E. coli* enterotoxigenic with the stable and unstable toxin, and *E. coli* enteropathogenic OK 111. The administration of *L. plantarum* DAD-13 into Wistar rats also affect the microbiota in their fecal sample

(Sumaryati et al., 2009). Rahayu et al. (2016), reported that *L. plantarum* DAD-13 was able to survive and colonize the gastrointestinal tracts of healthy Indonesian volunteers.

Developing indigenous probiotics as a starter for fermentation of dairy product is quite challenging. In order to be accepted by the consumers, sensory properties of the product play an important role. The aim of this study is to evaluate the sensory properties of the yogurt-like drink and yogurt-set like produced by indigenous probiotics for market test.

Materials and Methods

Sample Preparation

This research used methanol, ethyl acetate, Folin Ciocalteu reagent, gallic acid, tannic acid (Sigma Chemical Co. St. Louis USA) (+)-catechine, rutin, quercetin (Waco Pure Chemical Industry-Osaka Japan), butylated hydroxyanisole/BHA (Sigma Chemical Co.), aqueous Na_2CO_3 , Tween-40, HCl, buffer phosphate pH 7, ferrous chloride (FeCl_2), ferric chloride (FeCl_3), ammonium thiocyanate, $\text{K}_3\text{Fe}(\text{CN})_6$, trichloroacetic acid (TCA), tungstophosphoric acid, 1,1-diphenyl-2-picryl hydroxyl radical (DPPH) and linoleic fatty acid, all in analytical grade. It also used rotary vacuum evaporator (IKA-RV 10 basic), vortex, incubator, water-bath shaker (Julabo SW 22), a UV-Visible spectrophotometer (UV-1601 Shimadzu) and HPLC-DAD Hitachi Auto sampler L-2200 (Berkshire, UK).

Plant Authentication and Extracts Preparation

Maintenance of Culture

Probiotic strains used in this study were *Lactobacillus plantarum* DAD-13 which was isolated from *dadih* – traditional fermented buffalo milk and *Lactobacillus plantarum* MUT-7 which was isolated from *gatot* – traditional fermented raw cassava. The additional strains used were

Streptococcus thermophilus DAD-11, commercial yogurt starter *Streptococcus thermophilus* and *Lactobacillus bulgaricus* obtained from Food and Nutrition Culture Center Collection (FNCC), Center for Food and Nutrition Studies, Universitas Gadjah Mada, Yogyakarta, Indonesia. The strains were preserved in ampoules and kept at Food and Nutrition Culture Center Collection (FNCC), Center for Food and Nutrition Studies, Universitas Gadjah Mada, Yogyakarta, Indonesia. The strain was grown in MRS (de Man, Ragosa, Sharpe) media at 30°C for 24 hours before used.

Preparation of Starter Culture

Starter culture was made using 300 mL of coconut water as a media with the addition of 250 mL of peptone, 400 mL of bean sprout extract, 20 mL of tomato extract, 30 grams of sucrose and 30 mL of distilled water. Media were homogenized and sterilized at 121°C for 15 minutes. The amount of 50 mL of each indigenous probiotic strain was inoculated into the media (10% sterilized skim milk). While the commercial yogurt starter used was obtained from PT. Yummy Food Utama.

Production of Yogurt-like Products

The production of yogurt-like products was carried out in PT. Yummy Food Utama in Jakarta. Two kinds of products used for this study were in form of yogurt-like set and yogurt-like drink. The number of indigenous probiotics added was 3.7×10^{10} CFU/mL. The milk was fermented and then mixed with sugar and fruit flavoring compound. Yogurt-like drink was packaged in 180 mL plastic bottle, while yogurt-like set was packaged in 250 mL plastic cup. Commercial yogurt-set used as control was yogurt-set produced by PT. Yummy Food Utama.

Sensory Evaluation

In order to ensure that the quality of food is appealing and appetising or more specifically that the eating quality attributes of aroma, taste, aftertaste, tactual properties and appearance is acceptable, method of deciding said quality of a food is through sensory evaluation (Singh-Ackbarali and Maharaj, 2014). The responses to these attributes can be used to know the preference of the consumers on yogurt products made of indigenous strain and commercial starter. The sensory evaluation was divided into four tests. The first evaluation was home-use test using families, the second was central location test held in Faculty of Agricultural Technology Universitas Gadjah Mada, whereas third and fourth evaluation were central location test held in seminar auditorium.

Home-use test was done in order to obtain responses from families which were considered the potential consumers for yogurt products. Home-use test was chosen because in home-use test, the opinion of the whole family members and their influence toward each other are taken into account (Meilgaard et al., 1999). Therefore, it is expected that the responses from home-use test can represent an even broader range of consumers.

Central location tests are usually conducted in an area where many potential purchasers congregate or can be assembled (Meilgaard et al., 1999). In this research, faculty area and seminar auditorium were chosen because there were many potential consumers for yogurt products in those places.

The first evaluation was the family perception of yogurt-like drink conducted in Yogyakarta involving 100 family members. The amount of eight bottles of yogurt-like drink (four of peach flavor and four of strawberry flavor) and questionnaires were given to each family members. Sensory

attributes such as creaminess, sweetness, viscosity, and sourness were measured.

The second sensory evaluation involving 53 students in Yogyakarta was intended to evaluate the sensory properties of yogurt-like set products using different mixtures of strains, which were a combination of *L. plantarum* MUT-7 and *S. thermophilus* DAD-11; and combination of *L. plantarum* DAD-13 and *S. thermophilus* DAD-11. Commercial yogurt from PT. Yummy was used as the control.

For the third sensory evaluation, 119 university members (consist of students and staffs) of Universitas Gadjah Mada, Yogyakarta were also recruited as the panelist to evaluate the sensory properties of yogurt-like drink containing *L. plantarum* MUT-7 and *S. thermophilus* DAD-11. Commercial yogurt from PT. Yummy was used as the control.

The final sensory evaluation was performed using 101 students from Universitas Gadjah Mada in Yogyakarta and 91 students from Universitas Katholik Widya Mandala in Surabaya as the panelists to compare the sensory properties of yogurt-like set containing a combination of *L. plantarum* DAD-13 and *S. thermophilus* DAD-11 with commercial yogurt set.

Results and Discussion

Family Perception Towards Yogurt-like Drink Containing Indigenous Probiotics

The family perception evaluation was performed in Yogyakarta. Initially, a total of 48 housewives were recruited to bring a total of eight bottles of products (ratio between peach and strawberry flavored product was 1:1) to be given to their family members. Each family member had to consume two yogurt-like drinks (one strawberry flavored and one peach flavored). The family member was asked to answer the questionnaire given by the researchers. The total of family members participated in this sensory evaluation was 100 persons.

Sensory attributes i.e. sweetness, sourness, viscosity, and creaminess of two different flavors of yogurt-like drink were measured. The scale ranged from 1 (the weakest sensation) to 5 (the strongest sensation). The affective evaluation was also performed in the scale of 1 (the most unfavored) to 5 (the most favored) in order to evaluate consumer's preference. The panelists were also asked for their social-economy backgrounds such as their latest education, amount of income, and their eating habits.

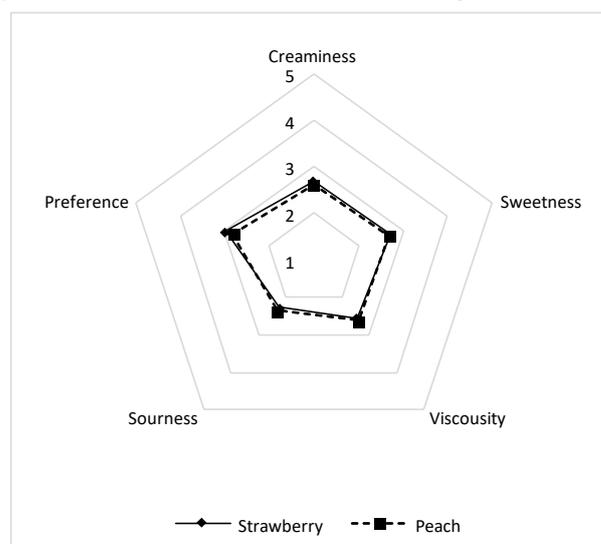


Figure 1. Family perception towards yogurt-like drink containing indigenous probiotics with different flavors.

The result (**Figure 1**) showed that there was no significant difference in sensory properties between peach-flavored yogurt-like drink and strawberry-flavored yogurt-like drink. The overall perception of panelist towards both products was around the score of 3, which showed neutral position. This might be resulted by the eating habits of the panelists and might also be affected by their income. Daily consumption of fermented milk and regular buying of such products were not their priority of household needs, therefore their responses were inclined towards neutral due to the unfamiliarity and lack of previous experiences in consuming such products.

Comparison of Sensory Properties of Yogurt-like Set Using Two Different Indigenous Probiotics

Sensory attributes (creaminess/mouthfeel, sweetness, consistency, sourness, and lingering aftertaste) and panelists' preference of yogurt-like set containing indigenous probiotics of *L. plantarum* DAD-13 combining with lactic acid bacteria *S. thermophilus* DAD-11 were measured and compared to those of yogurt-like set containing combination of indigenous probiotics *L. plantarum* MUT-7 and lactic acid bacteria *S. thermophilus* DAD-11. The two products were also compared to the control using the same parameters. The control was

commercial yogurt-like set from PT. Yummy. The scale ranged from 1 (the weakest sensation) to 5 (the strongest sensation). The affective evaluation was also performed in the scale of 1 (the most unfavored) to 5 (the most favored) in order to evaluate consumer's preference. A total of 53 students were recruited as panelist.

Sensory evaluation of yogurt-like set products is shown in **Table 1** and illustrated in **Figure 2**. The result showed that there is no significant difference ($p > 0,05$) in all sensory attributes between the two yogurt-like set products. Compared to the control, only sweetness attribute showed significantly different result as yogurt-like set products were sweeter than the control. This may be caused by the characteristics of indigenous probiotics (MUT-7 and DAD-13), which have slower growth rate compared to commercial bacteria, therefore resulted in higher complex sugar substrate left in the yogurt-like set compared to in commercial product. However, further research is needed for this matter.

Based on panelist's preference, it is clearly shown that the panelists preferred to consume yogurt-like set products which were made from milk fermented using indigenous probiotics. This result further emphasizes the potential of indigenous probiotics to be applied for the production of yogurt-like set.

Table 1. Comparison of sensory properties of yogurt-like set using two different indigenous probiotics.

	<i>L. plantarum</i> DAD-13 & <i>S. thermophilus</i> DAD-11	<i>L. plantarum</i> MUT-7 & <i>S. thermophilus</i> DAD-11	Control (<i>L. bulgaricus</i> & <i>S. thermophilus</i>)
Mouthfeel/Creaminess	3.08 ^a	3.11 ^a	2.85 ^a
Sweetness	2.26 ^b	2.38 ^b	1.81
Consistency	2.55 ^c	2.75 ^{cg}	2.94 ^g
Sourness	2.57 ^d	2.57 ^d	2.23 ^d
Lingering Aftertaste	2.72 ^e	2.62 ^e	2.75 ^e
Preference	2.53 ^f	2.70 ^f	2.19

Note: The number which is followed by the same alphabet on the same row showed no significant difference based on t-test analysis with $\alpha=0.05$.

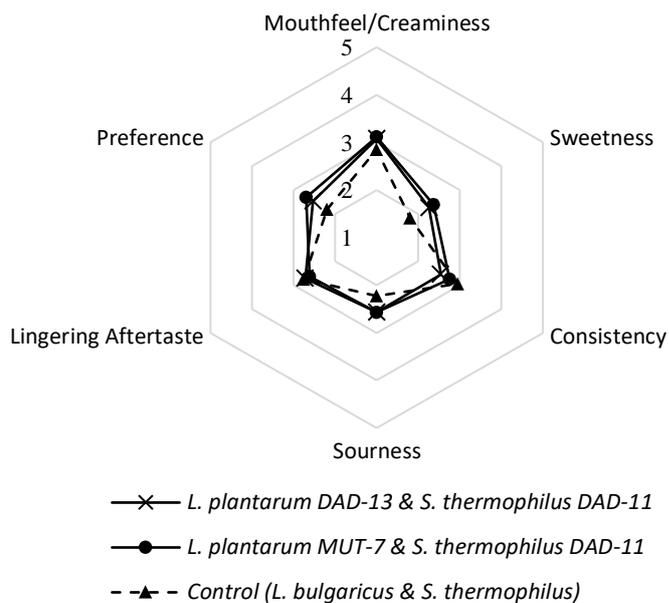


Figure 2. Sensory properties evaluation of yogurt-like set products using different mixtures of strains, which were combination of *L. plantarum* MUT-7 and *S. thermophilus* DAD-11; and combination of *L. plantarum* DAD-13 and *S. thermophilus* DAD-11. A yogurt made from milk fermented using commercial yogurt starter (*S. thermophilus* and *L. bulgaricus*) was used as the control.

Sensory Properties of Yogurt-like Drink Containing Indigenous Probiotics

Sensory properties (creaminess/mouthfeel, sweetness, consistency, sourness, and lingering aftertaste) and panelists' preference of yogurt-like drink containing indigenous probiotics of *L. plantarum* MUT-7 combined with lactic acid bacteria *S. thermophilus* DAD-11 were measured and compared to those of control. The control was commercial yogurt drink from PT. Yummy. The scale ranged from 1 (the weakest) to 5 (the strongest). The Affective evaluation was also performed in the scale of 1 (the most unfavored) to 5 (the most desired) in order to evaluate consumer's preference. A total of 119 students were recruited as the panelist.

Sensory evaluation of yogurt-like drink containing indigenous probiotics is shown in **Table 2** and illustrated in **Figure 3**. The result showed that there was a significant difference in creaminess or mouthfeel, sweetness, and sourness attributes ($p < 0,05$). It is shown that yogurt-like drink was creamier, more sour, and sweeter than the

control. On the other hand, attributes of consistency and lingering aftertaste between two products showed no significant difference (p -value 0.32 and 0.54, respectively). Interestingly, based on affective preference evaluation, panelist slightly preferred the yogurt-like drink with indigenous probiotics better than control even though it was not significantly different ($p < 0.05$).

Comparison of Sensory Properties of Yogurt-like Set Products in Two Different Cities

The sensory properties, i.e. aroma, mouthfeel/creaminess, sweetness, compactness, and lingering aftertaste of yogurt-like set containing *L. plantarum* DAD-13 and *S. thermophilus* DAD-11 were evaluated and compared with those of commercial yogurt in market produced by PT. Yummy. The scale ranged from 1 (the weakest) to 5 (the strongest). The affective evaluation was also performed in the scale of 1 (the most unfavorable) to 5 (the most desired) in order to evaluate consumer's preference. Both sensory and affective

Table 2. Sensory properties of yogurt-like drink containing indigenous probiotics

	Control (<i>L.bulgaricus</i> & <i>S. thermophilus</i>)	Yogurt-like drink (<i>L. plantarum</i> MUT-7 & <i>S. thermophilus</i> DAD-11)	p-value ($\alpha = 0,05$)
Mouthfeel/creamy	2.82	3.13	0.01
Sweetness	1.87	2.39	0.00
Consistency	2.88	2.75	0.32
Sourness	2.28	2.76	0.00
Lingering Aftertaste	2.72	2.80	0.54
Preference	2.17	2.78	0.00

Note: p-value was measured using t-test analysis with $\alpha=0.05$.

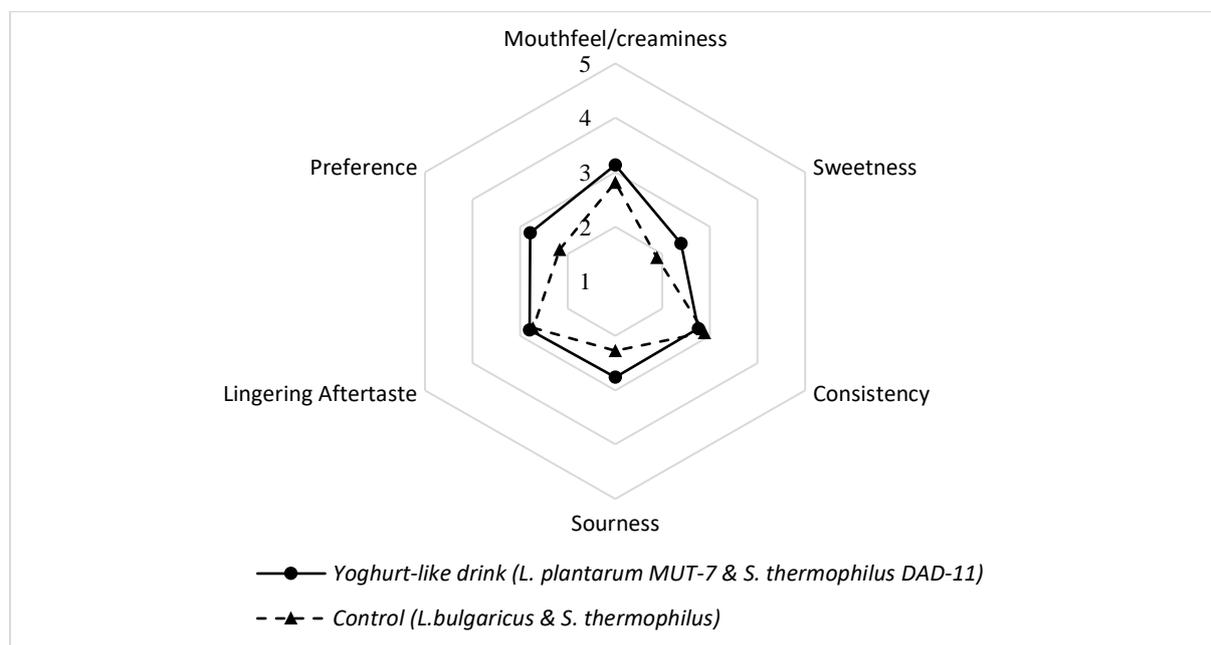


Figure 3. Sensory properties evaluation of yogurt-like drink containing *L. plantarum* MUT-7 and *S.thermophilus* DAD-11 A yogurt made from milk fermented using commercial yogurt starter (*S. thermophilus* and *L. bulgaricus*) was used as the control.

evaluation were performed in two different cities which were Yogyakarta (101 panelists) and Surabaya (91 panelists).

The sensory evaluation performed in Yogyakarta is shown in **Table 3** and illustrated in **Figure 4**. Based on the evaluation done by the panelist in Yogyakarta, the aroma, mouthfeel, compactness, and lingering aftertaste of commercial yogurt were much stronger than those of yogurt-like set ($P<0,05$). The important feature of yogurt-like set was that it had less lingering aftertaste

which was favored for product such as yogurt. The sweetness and sourness of commercial yogurt were higher but not significantly different compared to those of yogurt-like set. Panelists' preference on both yogurt-like set and commercial yogurt set was not significantly different. This indicated that yogurt-like set containing indigenous probiotics was potential to be developed for market in Yogyakarta.

The sensory evaluation performed in Surabaya is shown in **Table 4** and illustrated in

Figure 5. Based on the evaluation done by the panelist in Surabaya, commercial yogurt set had significantly higher score in all of measured sensory properties. According to

the affective evaluation, panelist in Surabaya preferred commercial yogurt rather than yogurt-like product with indigenous probiotics.

Table 3. Sensory evaluation of yogurt-like set using indigenous probiotics and commercial yogurt performed in Yogyakarta (101 panelist)

	Yogurt-like set containing <i>L. plantarum</i> DAD-13 and <i>S. thermophilus</i> DAD-11	Commercial yogurt set	p-value ($\alpha=0,05$)
Aroma	3.11	3.40	0.03
Mouthfeel	2.71	3.49	0.00
Sweetness	2.46	2.60	0.31
Compactness	2.68	3.62	0.00
Sourness	2.78	2.86	0.61
Lingering aftertaste	2.87	3.20	0.02
Preference	2.61	3.15	0.00

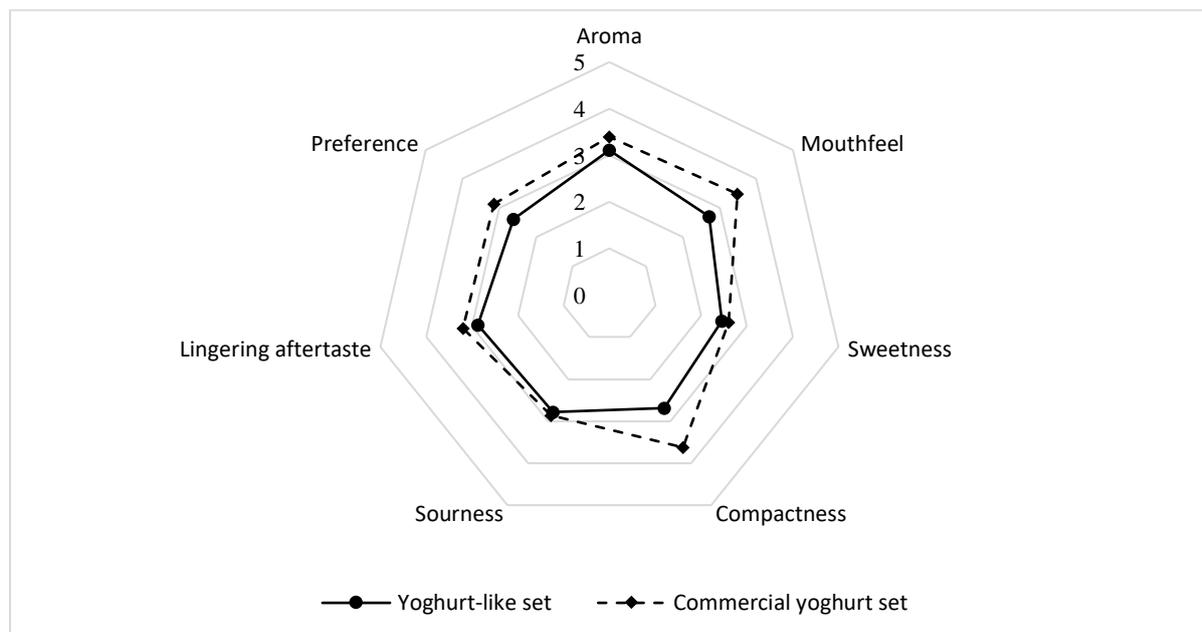


Figure 4. Comparison of sensory properties of yogurt-like set using indigenous probiotics *L. plantarum* DAD-13 and lactic acid bacteria *S. thermophilus* DAD-11 with commercial yogurt. Sensory evaluation was taken place using 101 students from Yogyakarta.

Table 4. Sensory evaluation of yogurt-like set using indigenous probiotics and commercial yogurt performed in Surabaya (91 panelist)

	Yogurt-like set containing <i>L. plantarum</i> DAD-13 and <i>S. thermophilus</i> DAD-11	Commercial yogurt set	p-value ($\alpha=0,05$)
Aroma	3.14	3.55	0.019
Mouthfeel	2.78	3.25	0.002
Sweetness	2.03	2.41	0.015
Compactness	2.79	3.33	0.001
Sourness	2.53	2.95	0.008
Lingering aftertaste	2.47	2.96	0.003
Preference	2.18	2.88	0.000

Note: p-value was measured using t-test analysis with $\alpha=0.05$.

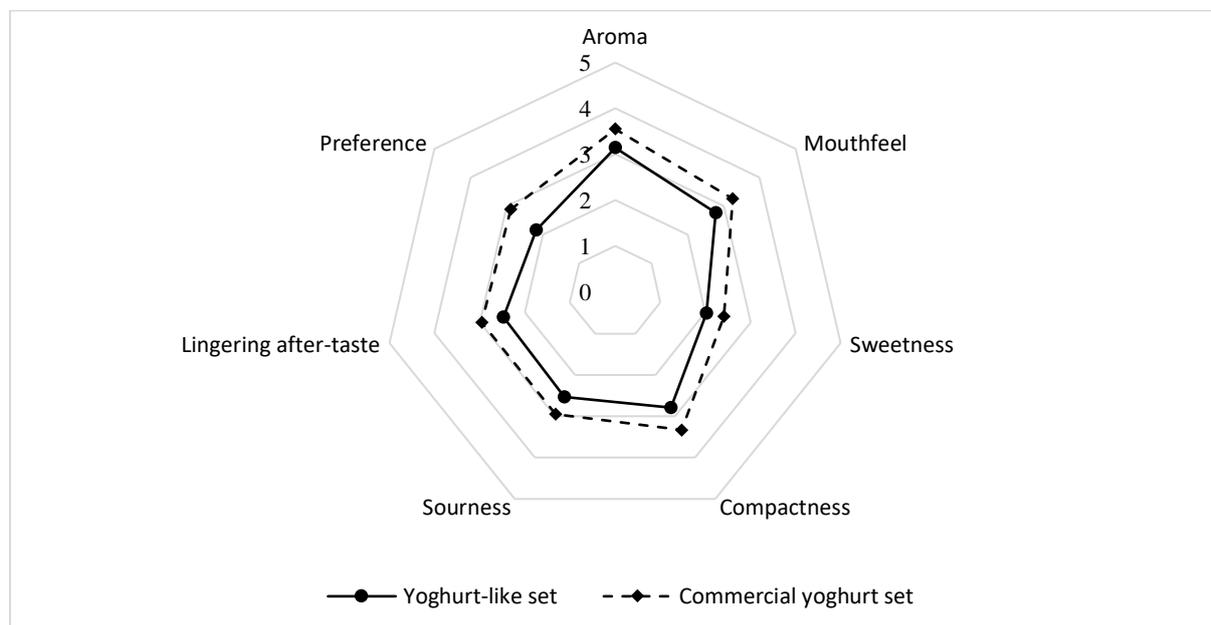


Figure 5. Comparison of sensory properties of yogurt-like set using indigenous probiotics *L. plantarum* DAD-13 and lactic acid bacteria *S. thermophilus* DAD-11 with commercial yogurt. Sensory evaluation was taken place using 91 students from Surabaya.

Conclusion

The indigenous probiotic *L. plantarum* DAD-13 and *L. plantarum* MUT-7 were potential to be used as a starter culture for the production of yogurt-like set and yogurt-like drink. The combination of indigenous probiotics and indigenous lactic acid bacteria *S. thermophilus* DAD-11 resulted in better sensory properties of yogurt set compared to combination of *L. bulgaricus* and *S. thermophilus* as shown in sensory evaluations of yogurt set in

Yogyakarta and the preferred attributes such as lower lingering taste.

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