

## POTENTIAL OF BUTTERFLY PEA FLOWER (*CLITORIA TERNATEA* L.) TEA AND KOMBUCHA AS NEUTRACETICAL DRINKS TO IMPROVE LIPID PROFILE OF DYSLIPIDEMIA SUBJECTS

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### ABSTRACT

Dyslipidemia is characterized by abnormal lipid levels and this condition can improve with a good lifestyle and consuming edible flowers, which have health benefits. Indonesia is known for its various biodiversity edible flowers; one is the Butterfly Pea Flower/BPF. Technological developments have opened up opportunities for developing kombucha from BPF tea that contains probiotics and antioxidants. Clinical trials with BPF kombucha have never been carried out, so the researchers intend to examine the potential of BPF kombucha compared to BPF tea for improving lipid profiles of dyslipidemia subjects. The research design used a Randomized Controlled Trial (RCT) with 11 subjects/intervention groups. The intervention was conducted for 4 weeks with 125 ml of BPF tea or BPF kombucha. The biomarkers observed were lipid profile (total cholesterol/TC, triglycerides/TG, HDL cholesterol/HDL-C and LDL cholesterol/LDL-C). The difference in lipid profile improvement was higher in the BPF kombucha group compared to BPF tea, although it was not significantly different ( $p>0.05$ ). The results show that BPF tea and BPF kombucha have the same potential to improve lipid profiles.

**Keywords:** *Clitoria ternatea* L.; dyslipidemia; kombucha; lipid profiles; nutraceuticals

### ABSTRAK

Dislipidemia ditandai dengan kadar lipid yang tidak normal dan kondisi ini dapat diperbaiki dengan pola hidup yang baik dan konsumsi *edible flower*, yang memiliki manfaat bagi kesehatan. Indonesia dikenal memiliki keanekaragaman hayati *edible flower*, salah satunya adalah Bunga Telang/BPF. Perkembangan teknologi telah membuka peluang untuk mengembangkan kombucha dari teh BPF yang mengandung probiotik dan antioksidan. Uji klinis pada kombucha BPF belum pernah dilakukan, sehingga peneliti bermaksud untuk menguji potensi kombucha BPF dibandingkan dengan teh BPF untuk memperbaiki profil lipid subjek dislipidemia. Desain penelitian menggunakan Randomized Controlled Trial (RCT) dengan 11 subjek/kelompok intervensi. Intervensi dilakukan selama 4 minggu dengan memberikan masing-masing 125 ml teh BPF atau kombucha BPF. Biomarker yang diamati adalah profil lipid (kolesterol total/TC, trigliserida/TG, kolesterol HDL/HDL-C dan kolesterol LDL/LDL-C). Perbedaan perbaikan profil lipid lebih tinggi pada kelompok kombucha BPF dibandingkan dengan teh BPF, meskipun tidak berbeda secara signifikan ( $p>0,05$ ). Hasil penelitian menunjukkan bahwa teh BPF dan kombucha BPF memiliki potensi yang sama untuk memperbaiki profil lipid.

**Kata kunci:** *Clitoria ternatea* L.; dislipidemia; kombucha; nutrasetikal; profil lipid

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## INTRODUCTION

Dyslipidemia is a condition that describes abnormal lipid levels in the human body. In 2018, the prevalence of total cholesterol (TC), triglycerides (TG), and LDL cholesterol (LDL-C) was still high in Indonesia at 7.6, 13.8, and 9%, respectively (Kementrian Kesehatan RI, 2018). Dyslipidemia is associated with the risk of heart disease; from the national basic health research data of Indonesia, it is known that the prevalence of heart disease is increasing (Kementrian Kesehatan RI, 2018). One way to improve one's lifestyle is through diet, which helps maintain a normal lipid profile.

In efforts to prevent and minimize the risk of non-communicable diseases, Indonesian people have the habit of consuming plant infusions or herbal medicine, which has health benefits (Andriati and Wahjudi, 2016). Indonesia is known for its various biodiversity, which can have positive health benefits, including multiple types of edible flowers (Kresnapati, Ramandha and Indriani, 2022). One is the Butterfly Pea flower/BPF (*Clitoria ternatea L.*) (Kumari, Ujala and Bhargava, 2021) which is known by Indonesian society as the Telang flower. This flower, with a distinctive blue color, is often used as a natural food coloring (Angriani, 2019). BPF contains polyphenols as antioxidants, antidiabetic, anti-obesity, anti-inflammatory, and anticancer (Marpaung, 2020), and also improves cholesterol metabolism in experimental animals (Wang *et al.*, 2022) while improving cholesterol metabolism in experimental animals (Marpaung, 2020).

Usually, BPF is consumed by being brewed. Technological developments open up opportunities for developing food and beverage products, including kombucha from this BPF tea. BPF contains anthocyanin which can act as an antioxidant in

addition to being a color pigment (Fu *et al.*, 2021). They have high potential in the food industry, but anthocyanins have an alkaline pH so they have low stability (Fu *et al.*, 2021). Anthocyanins are more stable in acidic conditions and are polar. This is an opportunity to develop a kombucha drink from BPF tea. Kombucha is acidic (Bishop *et al.*, 2022), therefore, if BPF tea is formulated into a kombucha drink, the anthocyanin content contained in it is more stable. Public interest and consumption of kombucha continue to increase, and consumers are looking for alternative drinks to replace fizzy drinks that taste good and provide health benefits (Kim and Adhikari, 2020). Kombucha is a fermented tea drink using SCOBY (Symbiotic culture of bacteria & yeast) (Diez-Ozaeta and Astiazaran, 2022) and is usually made from natural ingredients. The fermentation process in making kombucha can increase health potential due to the increased probiotic and antioxidant content. Kombucha has the potential as a probiotic that can help reduce TC, TG, and LDL-C concentrations (Wang *et al.*, 2021) and antioxidants that can inhibit lipase enzymes, reduce LDL, TG, and increase HDL cholesterol (HDL-C) in experimental animals (Permatasari *et al.*, 2022). Previous research on BPF kombucha was only carried out at the pre-clinical stage (Permatasari *et al.*, 2022). No clinical trials have ever been conducted to evaluate the potential of BPF kombucha in dyslipidemia conditions, and clinical trials on BPF tea have only been conducted on healthy subjects. Based on this, we intended to examine the potential of BPF kombucha compared to BPF tea for improving lipid profiles in dyslipidemia subjects.

## MATERIALS AND METHOD

### Design, Time, and Location

The design used was a Randomized Controlled Trial (RCT). The research was conducted in August-December 2023 in Jakarta, Indonesia. Ethics commission permission (ethical clearance) was obtained from the Health Research Ethics Committee of the Faculty of Medicine and Health, Universitas Muhammadiyah, Jakarta (UMJ) No. 143/PE/KE/FKK-UMJ/VII/2023.

### Number and Method of Taking Subjects

The minimum subjects from the calculation results were 10 people/group (anticipated dropout 10%; power test 95% d; and  $\alpha = 5\%$ ). There were two intervention groups: the BPF tea group and the BPF kombucha group. The choice of intervention site in this study was carried out purposely, with the subjects being private sector employees. Inclusion criteria include men and women aged 25-45 years, not menopause (women), LDL-C > 100 mg/dL (U.S. Department of health and human services, 2021), Body Mass Index (BMI) 18-27 kg/m<sup>2</sup>, and favors kombucha drinks. Exclusion criteria included having a history of heart disease or other serious chronic diseases and using drugs that affect lipid metabolism, smoking (Zhu *et al.*, 2013), pregnant, breastfeeding mothers (Lu *et al.*, 2015), as well as people with high acid intolerance, such as ulcer sufferers and those with kidney problems (Watawana *et al.*, 2015).

### Preparation of BPF Tea and BPF Kombucha

The ingredients for BPF tea were dried BPF and water, while for BPF kombucha were dried BPF, water, sugar (30%) (Kushargina *et al.*, 2023), SCOBY gel (10 gram; diameter 9 cm; thickness 0.6 cm) and SCOBY starter solution (1 week old). BPF were obtained from the "Bagus" BPF plantation in

Kulonprogo, Yogyakarta. SCOBY obtained from PT. Sila Agri Innovation. BPF tea was prepared by brewing 1 gram of dried BPF using 250 mL of water at a temperature of 75°C and a steeping time of 9 minutes. Preparing BPF kombucha based on Kushargina *et al.* (Kushargina *et al.*, 2024).

### Intervention Techniques

The intervention was carried out for 4 weeks (Uhren, Morgan-Bathke and McLimans, 2021) with a dose of 125 ml/day (Pennsylvania Department of Agriculture, 2017). BPF tea and BPF kombucha were given daily, and the recommendation was to consume them at cold temperatures and drink them after the main meal (Pennsylvania Department of Agriculture, 2017). During the research, subjects should not take any supplements.

### Subject Characteristic and Antropometric Variable

The variables observed were subject characteristics including education (high school and >high school), Body Mass Index/BMI (Thin <18.5 kg/m<sup>2</sup>, Normal=18.5-25 kg/m<sup>2</sup>, Overweight >25 - 27 kg/m<sup>2</sup>, Obese >27 kg/m<sup>2</sup>), waist circumference (male: no risk <90 cm, risky >90 cm; female: no risk <80 cm, risky >80 cm) (Wells and Fewtrell, 2006), % visceral fat (Normal: 0.5-9.5%, height 10-14.5%, very high 15-30%), % subcutaneous fat (male: low <10%, normal 10-20%, high >20-<25%, very high >25%; female: low <20%, normal 20-<30%, high 30-35%, very high ≥35%) (Kitchlew, Khan Chachar and Latif, 2017). Height was measured with a microtoise (accuracy of 0.01 cm), body weight was calculated with SECA® digital scales (precision 0.1 kg), and nutritional status was assessed using the anthropometric method/BMI (kg/m<sup>2</sup>). Body Impedance Analyzer (Omron) was used to measure

visceral fat and subcutaneous fat as part of body composition.

### **Blood Sample Collection and Analysis**

The subject's blood was taken pre-and post-intervention. Before taking blood, the subject was required to fast for 12 hours, and the subject must only consume water during this time. Medical staff drew 5 ml of the patient's blood from the cubital vein for a full lipid profile analysis (PERKENI, 2019). Tests for triglycerides (TG), total cholesterol (TC), high-density lipoprotein (HDL-C), and low-density lipoprotein (LDL-C) are included in the plasma lipid profile. A DiaSys brand reagent kit (Diagnostic Systems GmbH) was used for the plasma lipid profile assays (TC, TG, and HDL-C), and the solution's absorbance was measured at  $\lambda$  500 nm. LDL-C values are calculated using the Friedewald formula. The ATP III Guidelines are cited in the TC, TG, HDL-C, and LDL-C categories (U.S. Department of health and human services, 2021). LDLox was measured using enzyme-linked immunosorbent assay (BT Lab Human Oxidized LDL ELISA kit) from the blood serum of subjects before and after the intervention was carried out.

### **Data Processing and Analysis**

Statistical analysis An Independent t-test was used to analyze differences in subject characteristics, average lipid profiles between intervention groups. Tests of differences in mean changes in lipid profiles before and after intervention in each intervention group were analyzed using a paired sample t-test. Data analysis was carried out using a significance level of 0.05 (CI 95%).

## **RESULTS**

### **Subject Characteristics**

Subject characteristics can be seen in Table 1. There were 11 subjects per intervention group for a total of 22 subjects. Each intervention group consisted of 2 men and 9 women. Most subjects had a high school education level (77.27%). The subject's nutritional status was included in the normal (54.55%) and overweight (45.45%) categories. Apart from BMI, anthropometric measurements also include waist circumference measurements. The majority of subjects (77.27%) in the two treatment groups were not at risk of metabolic disorders characterized by a waist circumference <90 cm for men and <80 cm for women. All subjects also underwent body fat composition measurements, such as subcutaneous and visceral fat. A total of 14 subjects (63.64%) had visceral fat in the normal category with visceral fat levels of 0.5-9.5%; the remaining 7 people (31.28%) were in the high category, and 1 person (4.55%) was very high. About 9 subjects (40.91%) had subcutaneous fat in the high category, and 4 subjects (8.18%) had subcutaneous fat in the very high category. The statistical analysis results showed that the characteristics of subjects in the two treatment groups were not significantly different ( $P > 0.05$ ) in terms of all variables, ranging from education, nutritional status, waist circumference, and body fat composition.

**Table 1.** Subject Characteristics

Variable	BPF Tea		BPF Kombucha		Total		p*	
	n	%	n	%	n	%		
Education	Higher education	3	27.3	2	18.2	5	22.73	0.34
	Senior High School	8	72.7	9	81.8	17	77.27	
	Total	11	100	11	100	22	100	
Nutritional Status	Thin	0	0	0	0	0	0	0.53
	Normal	5	45.5	7	63.6	12	54.55	
	Overweight	6	54.5	4	36.4	10	45.45	
	Obese	0	0	0	0	0	-	
	Total	11	100	11	100	22	100	
	Mean ± SD	24.53 ± 2.26		24.39 ± 2.02				
Waist Circumference	No Risk	9	81.8	8	72.7	17	77.27	0.86
	Risky	2	18.2	3	27.3	5	22.73	
	Total	11	100	11	100	22	100	
	Mean ± SD	89.59 ± 8.67		86.82 ± 10.99				
Visceral Fat	Normal	7	63.6	7	63.6	14	63.64	0.76
	High	4	36.4	3	27.3	7	31.82	
	Very high	0	0	1	9.1	1	4.55	
	Total	11	100	11	100	22	100	
	Mean ± SD	8.77 ± 3.89		8.87 ± 3.88				
Subcutaneous Fat	Low	1	9.1	0	0	1	4.55	0.12
	Normal	2	18.2	6	54.5	8	36.36	
	High	6	54.5	3	27.3	9	40.91	
	Very high	2	18.2	2	18.2	4	8.18	
	Total	11	100	11	100	22	100	
	Mean ± SD	27.55 ± 8.68		27.55 ± 6.20				

Note: n= number of subjects; BMI= Body Mass Index; SD= standard deviation; \*Independent sample t-test, difference between BPF tea and BPF kombucha group

### Effect of BPF Tea and Kombucha on Subjects' Lipid Profiles

The average lipid profile of subjects based on treatment groups can be seen in Table 2. There was a decrease in TC, TG, and LDL-C and an increase in HDL-C after 28 days of intervention in all intervention groups. The difference in lipid profile changes was greater in BPF kombucha group, although not significant ( $p > 0.05$ ) compared to BPF tea group. Although it did not differ between intervention groups, there was an improvement in the lipid profile in both groups after intervention. Subjects in BPF tea group showed a significant reduction in TC, TG, and LDL-C ( $p < 0.05$ ) and for

BPF kombucha group, the decrease in TC and LDL-C and the increase in HDL-C were significant ( $p < 0.05$ ) as seen in Figure 1.

Improvements in the lipid profile can also be seen in the TC, TG, HDL-C, and LDL-C categories. The distribution of subjects' lipid profile categories according to treatment before and after the intervention can be seen in Table 3. There was an improvement in TC, HDL-C, and LDL-C in both groups. There was no change in the TG category before and after intervention in those two groups. Changes in LDL-C category in the BPF kombucha group were higher than in the BPF tea group.

Table 2. Average Subject’s Lipid Profiles and Oxidative Stress Based on Treatment

Variable	BPF Tea			BPF Kombucha			p
	Before intervention	After intervention	Δ	Before intervention	After intervention	Δ	
TC	207±27	198±23	(-)10±8	202±23	190±14	(-)12±12	0.504
TG	123±58	112±55	(-)12±9	111±52	100±36	(-)11±20	0.951
HDL-C	50±13	53±12	3±5	50±9	57±7	7±9	0.221
LDL-C	132±23	122±21	(-)10±7	130±23	113±16	(-)17±10	0.092
LDLox	201.7±2.2	191.1±5.4	(-)10.6±5.9	199.7±6.3	187.6±5.4	(-)11.9±4.2	0.289
SOD	56.1±20.7	61.4±18.4	5.4±4.1	46.1±8.8	66.3±14.1	20.2±12.2	0.002*

Note: Data are presented as mean ± SD; \*Correlation is significant at the 0.05 level (2-tailed)-Independent t-test between treatment groups. TC= Total Cholesterol (mg/dl); TG= Triglyceride (mg/dl); HDL-C= High-density Lipoprotein (mg/dl); LDL-C= Low-density Lipoprotein (mg/dl); LDLox= LDL oxidation (U/L); SOD=Superoxide dismutase (U/mL); Δ = delta change before and after intervention.

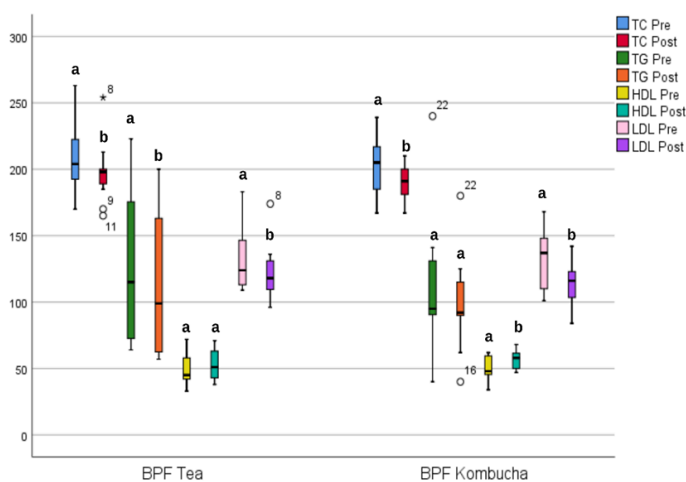


Figure 1. Changes in lipid profile before and after intervention in each group. The different superscript letter indicates significant difference between before and after intervention in each groups (paired sample t-test, at the 0.05 level (2-tailed)); TC= Total Cholesterol (mg/dl); TG= Triglyceride (mg/dl); HDL-C= High-density Lipoprotein (mg/dl); LDL-C= Low-density(mg/dl)

**Table 3.** Distribution Of Subjects' Lipid Profiles and Oxidative Status According to Treatment Before and After Intervention

Variable			BPF Tea				BPF Kombucha			
			Before		After		Before		After	
			n	%	n	%	n	%	n	%
TC	Desirable	<200 mg/dl	4	36.4	7	63.6	5	45.5	6	54.5
	Borderline high	200-239 mg/dl	6	54.5	3	27.3	6	54.5	5	45.5
	High	>240 mg/dl	1	9.1	1	9.1	0	0	0	0
	Total		11	100	11	100	11	100	11	100
TG	Normal	<150 mg/dl	7	63.6	7	63.6	10	90.9	10	90.9
	Borderline high	150-199 mg/dl	4	36.4	4	36.4	1	9.1	1	9.1
	High	200-499 mg/dl	0	0	0	0	0	0	0	0
	Total		11	100	11	100	11	100	11	100
HDL-C	Low	< 40 mg/dl	2	18.2	1	9.1	1	9.1	0	0
	Optimal	40-60 mg/dl	6	54.5	7	63.6	7	63.6	6	54.5
	High	> 60 mg/dl	3	27.3	3	27.3	3	27.3	5	45.5
	Total		11	100	11	100	11	100	11	100
LDL-C	Optimal	<100 mg/dl	0	0	1	9.1	0	0	1	9.1
	Near-optimal	100-129 mg/dl	6	54.5	6	54.5	5	45.5	9	81.8
	Borderline high	130-159 mg/dl	4	36.4	3	27.3	5	45.5	1	9.1
	High	160-189 mg/dl	1	9.1	1	9.1	1	9.1	0	0
	Total		11	100	11	100	11	100	11	100
LDLox	Low risk	< 60 U/L	0	0	0	0	0	0	0	0
	Moderate risk	60-70 U/L	0	0	0	0	0	0	0	0
	High risk	≥ 70 U/L	11	100	11	100	11	100	11	100
	Total		11	100	11	100	11	100	11	100
SOD	Normal	110–215 U/mL	0	0	1	9,1	1	9,1	1	9,1
	Low	<110 U/mL	11	100	10	90,9	10	90,9	10	90,9
	Total		11	100	11	100	11	100	11	100

Note: TC= Total Cholesterol; TG= Triglyceride; HDL-C= High-density Lipoprotein; LDL-C= Low-density Lipoprotein; LDLox= LDL oxidation; SOD=Superoxide dismutase; n= number of subject

## DISCUSSION

The subjects in this research were private workers. Good nutritional and health status will increase worker productivity. Most subjects had completed High school-level education (77.27%). In line with this, it was found that private employees in Indonesia are currently dominated by high school graduates (Projo and Pontoh, 2022). The subject's nutritional status was in the normal category (54.55%). Nutritional status is a risk factor for dyslipidemia (PERKENI, 2019). Besides, anthropometric

measurements also include waist circumference measurements. Waist circumference is known to be associated with the risk of metabolic disorders. Most subjects (77.27%) in the two treatment groups were not at risk of metabolic disorders. Waist circumference above normal is associated with the risk of increased cholesterol and heart disease (Cunha De Oliveira *et al.*, 2014).

Body composition is related to the incidence of dyslipidemia (Hong Son *et al.*, 2023). Increased visceral and trunk subcutaneous adipose tissue are

associated with higher TG and lower HDL-C levels. Excess body fat increased the probability of cholesterol above the reference value (170 mg/dL) by 21% (Oliosia *et al.*, 2019). A total of 14 subjects (63.64%) had visceral fat in the normal category with visceral fat levels of 0.5-9.5%; the remaining 7 people (31.28%) were in the high category, and 1 person (4.55%) was very high. Visceral fat covers the internal organs of the body. Increased visceral fat can increase the risk of death due to metabolic diseases, including cardiovascular. The visceral fat accumulation in the body is associated with increased serum lipids, especially total cholesterol and LDL (Lozano *et al.*, 2016). Like visceral fat, increased subcutaneous fat is a risk factor for various metabolic diseases.

The BPF tea group received 125 ml of the BPF tea/day for 28 days. BPF contain anthocyanins, which act as antioxidants. Anthocyanin is an important potential content in fruits and vegetables that has the potential for cardiovascular and chronic heart disease (Curtis *et al.*, 2009). In line with the results of this study, anthocyanin supplementation in clinical trials showed improvements in HDL-C and LDL-C levels in dyslipidemia subjects (Qin *et al.*, 2009). The meta-analysis results also showed that anthocyanin supplementation significantly reduced serum TC, TG, and LDL-C levels of patients with dyslipidemia and increased HDL-C (Liu *et al.*, 2016). Anthocyanin supplementation at 200-300 mg/day doses significantly reduces TC and LDL (Daneshzad *et al.*, 2019). Previous clinical studies used BPF tea with healthy adults as subjects showed changes in the subjects' plasma antioxidant capacity and glycemic response (Chusak *et al.*, 2018). Proving the effect of BPF on lipid profiles was previously mostly carried out at the pre-clinical stage with experimental

animals, proving that BPF extract has a hypolipidemic effect. (Wang *et al.*, 2022).

Subjects in the kombucha group received 125 ml/day of BPF kombucha for 28 days. Clinical studies administering BPF kombucha to human subjects have never been conducted. Previous clinical research using kombucha made from *Camelia Sinensis* tea leaves for 4 weeks showed improved lipid profiles (TC, TG, HDL-C, LDL-C), although not significant (Uhren, Morgan-Bathke and McLimans, 2021). The kombucha consumed in the study was 4 oz or the equivalent of 118 ml. Similar to the results of this study, the decrease in lipid profile in the subjects of this study was also not significant ( $P>0.05$ ) after being given BPF kombucha for 28 days. In this study, it was stated that the possible cause of the insignificant changes in lipid profiles due to the nutritional status of the subjects, most of whom were normal. Research can be conducted with a longer intervention time and a wider BMI range (Uhren, Morgan-Bathke and McLimans, 2021). In the study, subjects had a BMI range from normal to overweight (18.5-27 kg/m<sup>2</sup>); this was done because obese nutritional status is a confounding factor where people with obesity have greater risk factors for inflammation, which will influence the reduction and diversity of lipid profiles and oxidative status. A positive correlation exists between BMI and increased levels of TC, TG, and LDL-C, and a negative correlation with HDL-C levels (van der Berg *et al.*, 2016).

Although there was no significant difference in the lipid profile between the BPF kombucha and BPF tea groups, the improvement in the lipid profile was greater in the BPF kombucha group. This is because BPF kombucha has been proven to contain higher anthocyanins, phenols, flavonoids, and antioxidant

activity than BPF tea (Rosyanne Kushargina *et al.*, 2024b). The fermentation process and the addition of sugar in making kombucha can increase the antioxidant potential of BPF kombucha (Rosyanne Kushargina *et al.*, 2024a). Not only does it have antioxidant potential, but kombucha is also known as a probiotic drink (Selvaraj and Gurumurthy, 2023). The presence of acetic acid bacteria, lactic acid bacteria, and mold in kombucha can have a positive impact on Non Communicable Disease (NCDs). Meta-analysis results show that probiotic supplementation for 8 weeks can reduce TC, TG, and LDL-C and increase HDL-C (Salari *et al.*, 2021). Probiotics can increase intestinal microbiota to form *Short Chain Fatty Acid* (SCFA), suppressing LDL-C metabolism and reducing cholesterol absorption in the intestine (Selvaraj and Gurumurthy, 2023).

The metagenomic results in this study showed that the most abundant bacteria in BPF kombucha was *Komagataeibacter* (Rosyanne Kushargina *et al.*, 2024b). The *Komagataeibacter* genus is a type of Acetic Acid Bacteria (AAB) which has 14 species. This genus belongs to *Gluconacetobacter* and plays a role in carbohydrate metabolism, such as those related to glucose, glycerol, acetane, levan, and cellulose. *Komagataeibacter* is stated to be included in the probiotic category (Lavasani *et al.*, 2019), where probiotics play a positive role in cholesterol metabolism in the body (Vourakis, Mayer and Rousseau, 2021).

## CONCLUSION

The results of this study indicate that BPF tea and kombucha have the same potential to improve lipid profiles. To more improve the lipid profile, consume the BPF tea or kombucha and balance it by maintaining food intake and optimizing physical activity. Further studies need to be executed regarding

the metabolites that support the potential of BPF kombucha, especially for the lipid profile and generally for health.

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