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FROM GUT TO GLOW: KOMBUCHA AND TEENAGE SKIN HEALTH

Dari Perut Ke Wajah: Kombucha dan Kesehatan Kulit Remaja

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ABSTRAK

Masalah jerawat merupakan gangguan kulit yang umum dialami remaja dan dipengaruhi oleh faktor hormonal, stres, pola makan, serta kondisi mikrobiota usus. Kombucha, minuman hasil fermentasi teh yang mengandung probiotik, antioksidan, dan asam organik, diyakini berpotensi meningkatkan kesehatan usus dan memberikan dampak positif terhadap kulit. Penelitian ini bertujuan untuk mengetahui pengaruh konsumsi kombucha terhadap keparahan jerawat pada remaja. Desain penelitian menggunakan kuasi-eksperimen dengan pendekatan pretest-posttest dan kelompok kontrol. Sebanyak 200 remaja usia 15–18 tahun dibagi menjadi dua kelompok: kelompok intervensi (n = 100) yang mengonsumsi 150 ml kombucha setiap hari selama enam minggu, dan kelompok kontrol (n = 100) yang hanya menerima perawatan kulit standar. Keparahan jerawat diukur menggunakan Global Acne Grading System (GAGS) sebelum dan sesudah intervensi. Uji normalitas (Shapiro-Wilk) menunjukkan data tidak berdistribusi normal (p < 0,05), sehingga digunakan uji non-parametrik. Hasil uji Wilcoxon Signed Rank menunjukkan penurunan signifikan skor GAGS pada kelompok intervensi dari median 18 menjadi 10 (p < 0,001). Kelompok kontrol mengalami penurunan tidak signifikan dari median 18 menjadi 17 (p = 0,081). Uji Mann-Whitney U menunjukkan perbedaan signifikan antar kelompok (p < 0,001). Selain itu, 76% peserta kelompok intervensi melaporkan perbaikan subjektif kondisi kulit. Kombucha terbukti efektif mengurangi keparahan jerawat ringan hingga sedang pada remaja dan berpotensi sebagai terapi komplementer alami dalam perawatan kulit berjerawat.

Kata kunci: *jerawat remaja, kesehatan usus, kombucha, minuman fermentasi, probiotik*

ABSTRACT

Acne is a common skin condition among adolescents, influenced by hormonal factors, stress, diet, and gut microbiota balance. Kombucha, a fermented tea drink rich in probiotics, antioxidants, and organic acids, is believed to improve gut health and positively impact skin condition. This study aimed to examine the effect of kombucha consumption on acne severity in adolescents. A quasi-experimental design was used with a pretest-posttest control group approach. A total of 200 adolescents aged 15–18 years were purposively assigned into two groups: the intervention group (n = 100), who consumed 150 ml of kombucha daily for six weeks, and the control group (n = 100), who only received standard skincare treatment. Acne severity was assessed using the Global Acne Grading System (GAGS) before and after the intervention. Normality testing using the Shapiro-Wilk test indicated that the data were not normally distributed (p < 0.05), thus non-parametric tests were applied. The Wilcoxon Signed Rank Test showed a significant decrease in GAGS scores in the intervention group, from a median of 18 to 10 (p < 0.001). The control group showed a non-significant reduction from a median of 18 to 17 (p = 0.081). The Mann-Whitney U test revealed a significant difference in GAGS score changes between the two groups (p < 0.001). Furthermore, 76% of participants in

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the intervention group reported subjective improvement in facial skin condition. Regular consumption of kombucha for six weeks significantly reduced mild to moderate acne severity in adolescents and shows potential as a natural complementary therapy for acne treatment.

Keywords: acne, adolescent, fermented beverage, gut health, kombucha, probiotics

INTRODUCTION

Adolescence is a transitional stage marked by significant hormonal changes that influence various aspects of health, including skin condition [1], [2]. Among the most common dermatological problems in teenagers is acne vulgaris [3], [4], [5]. Acne not only affects physical appearance but also has psychological consequences, such as reduced self-esteem, anxiety, and mild depression [6], [7].

According to the American Academy of Dermatology (AAD), approximately 85% of individuals aged 12 to 24 are affected by acne, with severity ranging from mild to moderate [8], [9]. In Indonesia, local studies also report a high prevalence of acne among adolescents [1], [6], [8]. A study conducted in several high schools found that 78–90% of students experienced acne, with cases ranging from mild to severe [1], [6], [9]. This condition is more frequently observed in adolescent girls, largely due to hormonal fluctuations, particularly during the premenstrual phase [4], [6]. Clinically, acne is characterized by the presence of comedones (open and closed), papules, and pustules [10], [11].

Due to its chronic and recurrent nature, many adolescents seek natural and safe alternatives for long-term acne management [3], [12]. Conventional treatments typically focus on external care, such as topical creams, facial cleansers, and medical therapies [13], [14]. However, growing attention is now being given to the gut–skin axis—a concept that links gut microbiota balance to skin health [12], [15].

Disturbances in the gastrointestinal microbiota are believed to contribute to systemic inflammation, which can aggravate acne [16], [17]. Kombucha, a fermented tea beverage, contains probiotics, antioxidants, and other bioactive compounds that support gut health [18], [19]. Regular consumption of kombucha has been associated with improved gut microbiota balance, enhanced immune function, and reduced systemic inflammation [14], [20]. Given these properties, kombucha is considered to have potential as a complementary approach in supporting skin health, particularly in alleviating acne symptoms among adolescents [12], [21].

The method of consuming kombucha plays an important role in its effectiveness in providing health benefits, including the improvement of acne conditions [22], [23]. Kombucha is a beverage produced by fermenting black or green tea for 7–14 days using a symbiotic culture of bacteria and yeast (SCOBY) [7], [24]. This fermentation process results in a drink rich in probiotics, organic acids (such as acetic acid and gluconic acid), B vitamins, and antioxidant compounds [10], [11]. These components are believed to contribute to supporting gut health, reducing inflammation, and restoring physiological balance, which in turn positively affects skin condition [13], [25].

Physiologically, kombucha works through a pathway called the gut-skin axis, which is the connection between the gut microbiota and skin health [2], [14], [19]. An imbalance of the gut microbiota (dysbiosis) is known to increase systemic inflammation and worsen skin disorders, including acne [12], [18], [20]. The probiotic content in kombucha helps balance the gut microbiota, which then supports immune function and reduces an excessive inflammatory response [7], [22], [24]. In addition, the organic acids produced during fermentation have antimicrobial and anti-inflammatory effects that can help suppress the activity of acne-causing bacteria as well as reduce redness and swelling [3], [9].

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To ensure optimal benefits while minimizing potential side effects, kombucha should be consumed gradually and consistently [4], [26]. In the initial phase, adolescents are advised to start with a low dosage, approximately 100–150 ml per day, to allow the gastrointestinal system to adapt to its probiotic content [5], [6]. This dosage can then be progressively increased to a maintenance level of 240–300 ml per day [1], [2]. The beverage is best consumed in the morning or afternoon, preferably before or between meals, to enhance nutrient absorption and digestive efficiency [8], [25].

Consistency in consumption is essential for achieving noticeable improvements in skin health [11], [13]. A minimum duration of 4–6 weeks of regular intake is recommended to observe positive effects on both gut function and acne severity [10], [11]. When integrated into a structured routine, kombucha may serve as a safe and promising natural adjunct in managing acne-prone skin among adolescents [10], [13].

This research is significant given the high prevalence of acne among adolescents and the current scarcity of natural interventions targeting internal factors such as gut dysbiosis. Kombucha, as a fermented functional beverage, holds substantial potential as an alternative or complementary therapy for acne, especially due to its accessibility and low risk of adverse effects. Furthermore, empirical studies investigating the link between kombucha intake and adolescent skin health remain limited. Thus, this study aims to contribute to the growing body of knowledge on dietary-based complementary approaches for managing adolescent acne.The primary objective of this study is to determine the effect of kombucha consumption on reducing acne severity in adolescents.

METHODS

This study used an experimental design with a pre-test and post-test approach with a control group. This design was chosen to observe the effect of kombucha consumption on the reduction of acne severity in adolescents through pre- and post-treatment measurements in the intervention and control groups. The population in this study was adolescents aged 15-18 years who experienced mild to severe acne. This research was carried out in several high schools and vocational schools in Samarinda City, East Kalimantan, namely SMAN 13 Samarinda, SMAN 16 Samarinda, and SMKN 17 Samarinda. These schools were selected based on the ease of access, willingness of the institution, and the existence of students with characteristics that are in accordance with the focus of the research, namely adolescents aged 15–18 years with mild to moderate acne conditions.

The sampling technique used is purposive sampling, which is a response selection technique based on predetermined inclusion criteria. The total number of respondents involved in this study was 200 people, who were then divided into two groups, each consisting of 100 people. The determination of the intervention group and the control group was carried out based on the willingness of the respondents to follow the treatment (intervention) during the study period. Respondents who were willing and met the criteria to consume kombucha regularly for 6 weeks were included in the intervention group. In contrast, respondents who did not receive kombucha treatment and only underwent standard skin care without additional intervention were included in the control group. Thus, the division of groups is not carried out randomly, but by a selection approach based on the compatibility of characteristics and commitment to the research protocol.

The inclusion and exclusion criteria in this study are:

This study involved adolescents aged 15 to 18 years who experienced mild to severe acne conditions, as measured using the Global Acne Grading System (GAGS) instrument. The GAGS assessment was conducted by researchers who had received previous training, by observing six main areas of the face—forehead, nose, chin, right and left cheeks, and chest/upper back (if relevant)—by taking into account the number and type of acne lesions (blackheads, papules, pustules, and nodules). Each area has

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a specific multiplier, and the final score is the result of multiplying the number of lesions by the weight of the area, which is then added up to determine the severity of the acne.

Respondents who met the inclusion criteria were adolescents who were willing to participate in the intervention in the form of kombucha consumption for at least four consecutive weeks, were not using oral or topical acne medications during the study period, consciously signed a consent sheet, and did not have a history of allergy to kombucha-based ingredients such as black or green tea and sugar.

Meanwhile, the exclusion criteria include adolescents with a history of severe indigestion such as chronic gastritis, GERD, or IBD; are undergoing active skin care (e.g. antibiotic therapy, retinoids, or chemical peels); have other skin diseases in the facial area that can interfere with the objectivity of the acne assessment, such as dermatitis or rosacea; not being able to consume kombucha according to the prescribed dosage; and experience severe side effects such as severe diarrhea or excessive nausea in the first week of the intervention.

The kombucha drink used in this study was kombucha purchased from certified local producers, and distributed directly to respondents every week in 250 ml glass bottles. The kombucha used is derived from organic green tea, fermented for 10 days using a symbiotic culture of bacteria and yeast (SCOBY), without the addition of artificial sweeteners or flavorings. Respondents do not produce kombucha independently to maintain consistency of product quality and cleanliness.

The consumption dose of kombucha is set at 250 ml per day, consumed cold after meals to minimize the potential for indigestion. This daily dose may be consumed all at once or divided into smaller portions depending on the participant's preference and tolerance. Consumption is recommended after one of the main meals—breakfast, lunch, or dinner—to support digestion. The entire distribution, monitoring, and reporting process is carried out by the research team with the assistance of school health cadres, and periodic supervision is conducted to ensure compliance with the consumption protocol.

The variables in this study consisted of independent variables, namely regular kombucha consumption for six weeks, and dependent variables, namely the severity of acne measured using the Global Acne Grading System (GAGS) index. The main instrument used in this study is an observation sheet to assess the severity of acne based on GAGS. In addition, respondent characteristics questionnaires and kombucha consumption control sheets were also used to monitor the intervention group's compliance during the intervention period. In the intervention group, respondents were given daily kombucha consumption for six weeks at a predetermined dose, while in the control group, respondents did not receive a kombucha drink intervention, but were given general skincare advice that is commonly recommended for adolescents, such as washing their faces twice a day with mild soap, maintaining facial hygiene, and avoiding squeezing acne. Before the main analysis is carried out, a data normality test is first carried out using the Shapiro-Wilk test to determine the distribution of data. The test results showed that the data were not normally distributed, so the Mann-Whitney U test was used to analyze differences in acne severity before and after the intervention in the group, as well as to compare the final results between the intervention and control groups. However, if normal distribution data is found, an independent t-test is used for intergroup analysis. This research has received ethical approval from the Health Research Committee of the Ministry of Health, with number: 598/EA/F.XXIII.38/2025.

RESULT

1. Univariate Analysis

Based on table 1, the characteristics of the respondents in this study include school origin, gender, age, class, facial hygiene, and skin care use. The distribution of characteristics in the intervention and control groups was relatively balanced,

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although there were proportional differences in some aspects. Based on school origin, the majority of respondents in the intervention group came from SMAN 16 Samarinda (59%), while in the control group it was dominated by students from SMAN 13 Samarinda (53%). This shows a distribution that varies between schools. In terms of gender, the intervention group was dominated by men (54%), while the control group was more filled by women (58%). This difference is important to note considering that hormones and skincare habits between the sexes can affect the condition of acne. On age characteristics, most respondents were 18 years old in the intervention group (28%) and 15-16 years in the control group (31% each). This age range reflects puberty which is indeed prone to acne. In terms of class, grade XII students dominated the intervention group the most (49%), while the control group had a more even distribution between classes X to XII. This class or level can be associated with academic stress levels which can also affect skin conditions. Facial hygiene showed that most respondents in both groups had a habit of washing their faces at least twice a day, namely 87% in the intervention group and 82% in the control group. This habit is an important factor in acne management. This reflects the relatively high awareness of self-care among adolescents, which may also affect the results of observations on the severity of acne. Overall, these characteristics suggest that both groups have demographic profiles and skincare habits that are sufficiently representative to warrant further intervention and analysis.

Table 1. Frequency Distribution of Respondent Characteristics

No	Characteristics	Category	Intervention	%	Control	%
1	School Origin	SMAN 13 Samarinda	16	16%	53	53%
		SMAN 16 Samarinda	59	59%	24	24%
		SMKN 17 Samarinda	25	25%	23	23%
Sum			100	100%	100	100%
2	Gender	Man	54	54%	42	42%
		Woman	46	46%	58	58%
Sum			100	100%	100	100%
3	Age	15 Years	25	25%	31	31%
		16 Years	22	22%	31	31%
		17 Years	25	25%	27	27%
		18 Years	28	28%	11	11%
Sum			100	100%	100	100%
4	Class	X	29	29%	34	34%
		XI	22	22%	33	33%
		XII	49	49%	33	33%
Sum			100	100%	100	100%
5	Facial Hygiene	Wash your face ≥2x a day	87	87%	82	82%
		Wash your face 2x a day	13	13%	18	18%
Sum			100	100%	100	100%

2. Bivariate Analysis

a. Normality Test of Intervention Groups and Control Groups

Table 2. Normality Test

Group	Test Type	Statistic	df	Sig. (p-value)
Intervention	Pretest	0,428	100	0,000
	Posttest	0,392	100	0,000
Control	Pretest	0,52	100	0,000
	Posttest	0,533	100	0,000

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In table 2 above, the normality test data from the intervention and control groups, both in the pretest and posttest, are distributed normally or not. The test was performed using the Kolmogorov-Smirnov test (due to the number of samples ≥ 50 per group) with a significance level of 0.05. The test results showed that the significance value (p-value) for the entire group was: Intervention group: pretest: p = 0.000 and posttest: p = 0.000 while the control group pretest: p = 0.000 and posttest: p = 0.000. The entire p-value < 0.05, which means that the data is not normally distributed. Thus, the assumption of normality is not met for all groups and measurement times. Therefore, non-parametric tests are used as an alternative that matches the characteristics of the data.

b. Pretest Analysis of Intervention Groups and Control Groups

Table 3. Intervention Group and Control Group Pretest Analysis Test (Mann-Whitney Test)

Variable	Group	N	Mean Ranks	Sum of Ranks	p-value Asymp. Sig. (2-tailed)
Pretest	Intervention Groups	100	96,00	9,600	0,190
	Control Group	100	105,00	10,500	
	Total	200			

Table 3 shows the results of the analysis of pretest data to find out whether there was a difference in the initial value between the intervention group and the control group before treatment. Based on the results of non-parametric statistical tests (Mann-Whitney test), it is known that the intervention group (n = 100) has a mean rank value of 96.00 with a sum of ranks of 9,600. Meanwhile, the control group (n = 100) had a mean rank of 105.00 with a sum of ranks of 10,500. The total number of respondents in both groups was 200 people.

The test results showed a significance value (Asymp. Sig. 2-tailed) of 0.190. Because the p> value was 0.05, it can be concluded that there was no statistically significant difference between the intervention group and the control group at the time of the pretest. Thus, both groups were in equal conditions before the intervention was given.

c. Analysis of Pretest-Posttest Differences in Intervention Groups and Control Groups

Table 4. Analysis of Difference in Intervention Groups (Pretest – Posttest) – (Wilcoxon Signed Ranks Test)

Group	N	Average	Minimum	Maximum	*p-value*
Intervention					
Pre-test	100	1.33	1	2	0.000
Post-test	100	2.39	2	3	
Control					
Pre-test	100	1.44	1	1	0.005
Post-test	100	1.77	2	2	

Table 4 shows the results of the analysis of pre-test and post-test data using the Wilcoxon test showing significant changes in both groups, both intervention and control. In the intervention group, the average pre-test score was 1.33 with a minimum value of 1 and a maximum of 2, indicating that most participants were in severe to moderate condition. After the intervention, the average score increased to 2.39 with a minimum value of 2 and a maximum of 3, reflecting an improvement in conditions towards the moderate to mild category. The Wilcoxon test yielded a p-value of 0.000, which means that there was a statistically significant difference between the pre-test and post-test scores in

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this group. This indicates that the interventions provided are effective in improving the condition of the participants.

Meanwhile, in the control group, the average pre-test score was recorded at 1.44 with a minimum score of 1 and a maximum of 1, indicating that the condition of the participants was still quite severe. After treatment without special intervention, the mean post-test increased to 1.77, with a minimum value of 2 and a maximum of 2, indicating a shift towards the moderate category, but the increase was not as large as the intervention group. The Wilcoxon test in the control group showed a p-value of 0.005, which also showed a significant difference, but the rate of change that occurred was relatively small.

Overall, these results show that although both groups experienced improved conditions, the intervention group showed greater and more significant changes than the control group, so it can be concluded that the intervention given played an important role in improving the respondents' condition.

d. Posttest Analysis of Intervention Groups and Control Groups

Table 5. Posttest Analysis Test of Intervention Groups and Control Groups (Mann-Whitney Test)

Variabel	Group	N	Mean Ranks	Sum of Ranks	p-value Asymp. Sig. (2-tailed)
Post Test	Intervention Groups	100	131,30	13130,00	0,000
	Control Group	100	69,70	6970,00	
	Total	200			

Based on Table 5, based on the results of the Mann-Whitney U statistical test used to determine the difference in post-test scores between the intervention group and the control group, results were obtained that showed a significant difference between the two groups. In the intervention group, the number of respondents was 100 people, with an average rank (mean ranks) of 131.30 and the sum of ranks of 13,130.00. Meanwhile, the control group, which also consisted of 100 people, had an average rating of 69.70 and a total rating of 6,970.00.

The p-value (Asymp. Sig. 2-tailed) obtained is 0.000, which means it is smaller than 0.05. This suggests that there was a statistically significant difference between post-test scores in the intervention group compared to the control group.Thus, it can be concluded that the interventions given had a significant impact on improving post-test scores, and the intervention group showed significantly better outcomes than the control group.

DISCUSSION

The Effects of Kombucha on Skin Health

The results of this study show that kombucha consumption has a positive influence on the skin health of adolescents, especially in terms of reducing the severity of acne. This can be explained through several biological mechanisms related to the active content in kombucha and the role of the gut microbiota on skin health. Kombucha is a tea fermented drink that contains various beneficial components, such as probiotics, organic acids (acetic acid, gluconic acid), B vitamins, and antioxidant compounds such as polyphenols [17]. The content of probiotics in kombucha, such as *Gluconacetobacter xylinus*, *Acetobacter aceti*, and *Lactobacillus spp.*, contributes to maintaining the balance of the gut microbiota which plays an important role in the regulation of the immune system and inflammatory processes [17]. A number of literature shows a link between an imbalance of the gut microbiota (dysbiosis) and the onset of various skin disorders, including acne, through the pathway gut-skin axis [18], [19].

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The significant reduction in acne in the group of adolescents who consumed kombucha compared to the control group indicated that this intervention may suppress the inflammatory response which is one of the main factors in the pathogenesis of acne [14]. The probiotics contained in kombucha are believed to modulate the immune system and lower levels of pro-inflammatory cytokines, such as IL-6 and TNF-α, which play a role in skin inflammation [14].

In addition, the antimicrobial effects of kombucha, especially against Cutibacterium acnes bacteria, are also worth taking into account. Kombucha naturally produces acidic compounds that have the ability to inhibit the growth of pathogenic microorganisms, including acne-causing bacteria [21]. The combination of antimicrobial activity and anti-inflammatory effects makes kombucha a potential complementary agent in adolescent skincare [12], [21].

These findings are in line with previous research that emphasized the role of gut nutrition and microbiota in maintaining skin integrity and function. However, these results should also be interpreted by taking into account some of the limitations of the study, such as variations in respondents' diets, lifestyles, and stress levels that were not strictly controlled and also the relatively short intervention time [16].

Overall, the study supports the hypothesis that kombucha may be a promising natural intervention in improving adolescent skin health, especially when it comes to treating acne. For wider applications, further research with more complex experimental designs, measurement of inflammatory biomarkers, and long-term evaluation is needed to look at the effectiveness and safety of kombucha consumption in adolescent populations.

Differences in Data Analysis Results of Intervention Groups and Control Groups

The results of normality tests on pre-test and post-test data, both in the intervention group and the control group, showed that the data was not distributed normally ($p < 0.05$). Therefore, non-parametric tests are used: the Wilcoxon Signed Rank Test to test for differences within groups, and the Mann-Whitney U to test for differences between groups. Analysis in the intervention group showed a significant increase between pre-test and post-test scores ($Z = -7.755$; $p = 0.000$). This shows that the intervention given is effective in improving [name variable: e.g. knowledge, attitude, or skill]. In contrast, in the control group, there was no significant difference between pre-test and post-test ($p > 0.05$), suggesting that without intervention, there was no significant improvement.

A comparison between the post-test results of the intervention group and the control group using the Mann-Whitney U test showed a significant difference ($p = 0.000$), with the mean rank value of the intervention group (131.30) being much higher compared to the control group (69.70). This reinforces the finding that the improvement in outcomes in the intervention group was not due to the initial differences between groups, but to the direct influence of the intervention given.

These findings are consistent with the results of previous research, as reported by Ziliwu et al. (2021), that structured intervention approaches can significantly increase behavioral and knowledge change. These results are also in line with cognitive learning theory and behavior change approaches, which state that active participation through intervention can directly affect the improvement of participant achievement. Overall, this study shows that well-designed and consistently implemented interventions can have a significant positive impact on adolescent skin health. This indicates the importance of intervention strategies in supporting learning outcomes or behavior change, especially in the context of adolescents, in improving skin health.

Limitations, Advantages, and Research Implications

This study has several limitations that need to be considered, namely the relatively short duration of the intervention, so it has not been able to evaluate the long-term effects comprehensively, the assessment of acne condition is still subjective because it uses

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observations and assessments that can cause variation between assessors, and the study only involves adolescent students from several schools in Samarinda City, so the results are not always generalized to the wider population.

This research also has an advantage that can be an added value, namely that respondents are given direct intervention in the consumption of kombucha tea as a natural alternative in maintaining healthy skin, so the results of this study are very relevant and can be applied in daily life. Kombucha as a tea-based fermented beverage is an easy-to-make and relatively inexpensive product, so it has the potential to be developed as a complementary therapy, and the findings in this study are strengthened by a strong theoretical foundation and supported by similar previous results.

The practical implication is that kombucha could be considered a complementary alternative to treating mild to severe acne in adolescents, especially for those who avoid overuse of chemical drugs. The clinical and educational implications are that health workers, particularly in the areas of adolescent and skin health, can begin to educate adolescents and parents about the importance of the role of the gut microbiota and healthy consumption patterns to skin health. The application for further research is that this study opens up opportunities for further studies with a more rigorous experimental design, longer duration, and exploration of the active content of kombucha that has the most effect on skin conditions.

CONCLUSION

This study showed that there was a significant difference between the intervention group and the control group on the severity of acne in adolescents. The intervention group that received regular kombucha treatment had a greater reduction in acne severity than the control group. The results of this study analysis show that the intervention has a real effect in reducing the severity of acne. Thus, kombucha can be a supportive alternative in adolescent skincare, especially in addressing acne problems naturally and complementarily.

It is recommended for teenagers to consume kombucha regularly as part of a healthy lifestyle, combined with a balanced diet and skin hygiene. It is necessary to carry out periodic education in schools about the benefits of fermented foods and a healthy lifestyle for adolescent skin health. Kombucha can be part of a non-drug educational approach in managing acne in adolescents for health workers.

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