

ORIGINAL ARTICLE

Effect of Kapok Flower Honey (*Ceiba pentandra*) Addition on Antioxidant Activity, Total Flavonoid, Total Phenolic, and Lactose Levels in Goat's Milk Kefir

Angga Hardiansyah¹, Ibnu Malkan Bakhrol Ilmi², Avliya Quratul Marjan², Yessi Crosita Octaria², Karina Ana Saputri¹, Khodijah¹, Darmuin¹

¹ Department of Nutrition, Faculty of Psychology and Health, Walisongo State Islamic University, 50185 Semarang, Indonesia.

² Nutrition Study Program, Faculty of Health Sciences, Universitas Pembangunan Nasional Veteran Jakarta, 12450 Depok, Indonesia.

ABSTRACT

Introduction: Adding honey from Kapok flower may increase the bioactive component of Goat's milk kefir. This study aims to determine the antioxidant activity, flavonoid content, total phenolics and lactose in Goat's milk kefir added with Kapok flower honey. **Materials and methods:** This study used experimental design with a Completely Randomized Design (CRD). The formula was made at five levels (0, 10, 15, 20, and 25%) with three repetitions. Each formula was analyzed to determine antioxidant activity using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method, flavonoid content, total phenolics, and lactose using the UV-Vis Spectrophotometer method. The data obtained were analyzed using ANOVA and followed by Duncan test to determine differences in treatment effect. **Results:** Results showed that adding Kapok flower honey to the Goat's kefir increased the antioxidant content, with the highest value being at a concentration of 25% was 98979.13 ppm ($P < 0.05$). Total flavonoids and total phenolics increased with increasing concentration of kapok flower honey. The highest total flavonoids and total phenolics were found in 25% honey concentration, respectively 0.0265% ($P < 0.05$) and 0.0590 ($P < 0.05$). Adding kapok flower honey lowered the lactose levels in goat's milk kefir. The lowest lactose was found in 25% honey concentration, with a level of 2.4672% ($P < 0.05$). **Conclusion:** Kapok flower honey increases the antioxidant content, total flavonoids, and total phenolics, reducing the lactose levels in Goat's milk kefir.

Malaysian Journal of Medicine and Health Sciences (2024) 20(SUPP9): 85-90. doi:10.47836/mjmhs20.s9.14

Keywords: Antioxidant, Flavonoid, Goat's milk kefir, Kapok flower honey, Phenolic, Lactose

Corresponding Author:

Ibnu Malkan Bakhrol Ilmi, S.Gz., M.Si.

Email: ibnuilmi@upnvj.ac.id

Tel: +62 856-4919-0409

INTRODUCTION

Goat's milk kefir is a fermented goat's milk product made with kefir grains (1). Lactic acid bacteria and yeast facilitated the fermentation. Lactic acid bacteria in kefir include *Streptococcus* (2); *Lactobacillus lactis* and *Lactobacillus kefirianofaciens* (3) and have the task of converting lactose in milk into lactic acid with levels of around 0.8-1.1% and other organic acids such as pyruvate acid and citric acid (4). The yeast produces alcohol and carbon dioxide (CO₂), which provide a foamy effect and a fresh taste to the product (2).

Goat's milk has better nutritional content than cow's milk, such as a high content of essential amino acids (threonine, lysine, isoleucine, cysteine, tyrosine

and valine), minerals (potassium, chloride, calcium, phosphorus, selenium and zinc), vitamin A and lower lactose content (5). Goat's milk is easier to digest with lower allergenic properties because the size of the fat and protein globules is smaller than cow's milk. Therefore, kefir made using goat's milk is more suitable for lactose intolerant sufferers (6).

In addition to producing lactic acid, alcohol and carbon dioxide, Goat's milk kefir produces antioxidants, antibacterial, anti-cholesterol, and anti-diabetic substances (3). We added kapok honey to the goat's milk kefir to increase the potential of these bioactive components and improve the very sour taste of kefir, so that it can be liked by the public as a delicious functional food. Kapok honey is a special honey that can only be harvested once a year. Kapok honey is classified as Mono-floral honey, a premium honey with a unique organoleptic characteristic compared to multifloral honey (7). Besides that, pH of kapok flower honey is around 4.34 so pathogenic bacteria such as *Escherichia*

coli, *Corynebacterium diphtheriae*, and *Salmonella* find it difficult to grow and develop due to the acidic environment (8).

Previous research found that kapok honey is higher antioxidants than calliandra honey and rubber honey with an IC50 value of 16.83% (9) (10). The high antioxidant content derived from flavonoid and phenolic compounds, *Pinocebrin* (11). Antioxidants are bioactive components that play a role in preventing free radical oxidation reactions in lipid oxidation; they react with free radicals thereby reducing the capacity of free radicals to cause damage (12). This research aimed to determine how adding kapok honey affects the antioxidant activity and total flavonoids, phenolics, and lactose levels in Goat's milk kefir.

MATERIALS AND METHODS

Study Design and Time

This was an experimental study with a Completely Randomized Design (CRD). The formula was made at five levels namely P0 (control), P1 (10%), P2 (15%), P3 (20%), and P4 (25%) with three repetitions. Each formula (Table I) was analyzed to determine antioxidant activity using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method, flavonoid content, total phenolics, and lactose using the UV-Vis Spectrophotometer method. The research was carried out from June to August 2023 at the Nutrition Laboratory and Science and Technology Laboratory at Walisongo State Islamic University and Chem-mix Pratama Laboratory Bantul Yogyakarta.

Table I: Goat's milk kefir formulation with the addition of kapok flower honey.

Formula	Information
P0	Goat's milk kefir 1000 ml + kapok flower honey 0 ml (control)
P1	Goat's milk kefir 900 ml + kapok flower honey 100 ml
P2	Goat's milk kefir 850 ml + kapok flower honey 150 ml
P3	Goat's milk kefir 800 ml + kapok flower honey 200 ml
P4	Goat's milk kefir 750 ml + kapok flower honey 250 ml

Material

Kefir Production

In this research, kefir was made using goat's milk, kefir grains, and kapok flower honey. The goat milk used was obtained directly from UD. Mitra Agro Abadi Farm located in Tengeran, Semarang Regency. The kefir grains used come from kefir producers in Bergas Lor, Semarang Regency, while the kapok flower honey is obtained from beekeepers in Gadu Village, Pati Regency.

Fresh Goat's milk was pasteurised at 72°C for 15 seconds, and the temperature was reduced to ±25-27°C. Next, the milk was transferred to a fermenter, and 5% kefir seeds were added, then honey was added according to the designed formula, namely P0 (control), P1 (10%), P2

(15%), P3 (20%), and P4 (25%). The mix was ready for fermentation in a closed cupboard at room temperature (±25-27°C) for 24 hours. The final fermentation results were separated from the kefir grains using a filter and placed in bottles (13) (14).

Antioxidant Activity Test (Molyneux, 2004)

The method used is the DPPH Radical Scavenging method, which involves dissolving 1.97 mg of DPPH in 100 ml of methanol p.a. to obtain a concentration of 50 µM. One ml of goat's milk kefir is mixed with 4 mL of DPPH solution. The sample was then homogenized using a vortex and incubated for 30 minutes. The absorbance reading was conducted with a spectrophotometer with a wavelength of 517 nm. After getting the absorbance values for the blank and sample, calculate the %inhibition to get the equation $y=ax+b$ with $R^2 \geq 0.9$. Then determine the antioxidant activity (IC50) with the following formula:

$$\%Inhibition = \frac{\text{blank asorbance} - \text{sample asorbance}}{\text{blank asorbance}} \times 100\%$$

$$IC50 \text{ (ppm)} = \frac{50-b}{a}$$

Total Flavonoid Test (Spectrophotometry, quercetin)

Five ml of sample was weighed and diluted using 96% ethanol in a 100 ml volumetric flask and filtered using filter paper. One ml of the filtrate was put into a test tube, and then a 5% AlCl3 solution and 7 ml of 96% ethanol were added. The solution was homogenised using a vortex. Next, the absorbance was read using a spectrophotometer with a wavelength of 415 nm. A standard Quercetin solution with a concentration of 0.15 mg/ml is made by diluting 15 ml of quercetin with 96% ethanol to 100 ml (15).

Phenolic Test (Spectrophotometry, Gallic Acid)

In a 100 ml volumetric flask, 5 grams of the sample was diluted with distilled water, then centrifuged and filtered. One ml of filtrate was put into a test tube, and 0.5 ml of Follin Denis reagent (in a 1:1 ratio) was added and then stir until dissolved. After that, add 1 ml of saturated Na2CO3 and and then left for 10 minutes. Next, the absorbance was read using a spectrophotometer with a wavelength of 730 nm. Preparation of a phenol standard curve using a dilution of 114 mg gallic acid diluted with distilled water to 1000 ml to obtain a solution concentration of 0.114 mg/ml (15).

Lactose Test (Spectrophotometry, Nelson-Somogy)

One ml sample was diluted in a 100 ml volumetric flask using distilled water. Then, the sample is filtered using filter paper. Nelson's A reagent contains 25 g Na2CO3 (anhydrous), 25 g potassium-sodium tartrate, 20 g NaHCO3 and 200 g Na2SO4 (anhydrous) dissolved in 800 ml of H2O and diluted to 1 liter with distilled water. Nelson's B contains 15 percent Cu2SO4.5H2O and one drop of H2SO4 per 100 ml. One ml of Nelson C reagent

(Nelson A:B = 25:1) was added to 1 ml of filtrate and then heated in a water bath at 100°C for 30 minutes. After cooling, 1 ml of arsenomolybdate was added and left for 1 minute. Next, the absorbance was read with a spectrophotometer at a wavelength of 540 nm (16).

Statistical analysis

The data obtained were analyzed using Software Statistical Package for Social Science (SPSS) version 26 with One Way ANOVA test. If the p-value < 0.05 indicates that there is a real difference in each formula and it is necessary to be followed by the Duncan test to identify mean differences between formulas. The data presented in the table is the mean, standard deviation, and significance value (p-value).

RESULTS

Antioxidant Activity

The antioxidant activity value in this study is expressed in inhibitor concentration (IC50) and presented in Table II. It is a value that describes the sample's ability to reduce free radicals by 50%. The lower the IC50 value, the stronger the antioxidant activity (9). Our results show that the addition of Kapok honey had a significant effect (P < 0.05) on the antioxidant activity. In addition, the higher the addition of kapok honey, the stronger the antioxidant activity produced to ward off free radicals. The IC50 value of Goat's milk kefir with the addition of kapok honey in the various formulas were 98.97 ppm; 60.61 ppm; 49.73 ppm; 43.45 ppm; and 38.22 ppm respectively.

Table II: Analysis of Antioxidant Activity

Formula	Mean (±) SD	P (value)
P0	98,97 ± 0,383 ^a	<0,001
P1	60,61 ± 0,376 ^b	
P2	49,73 ± 0,174 ^c	
P3	43,45 ± 0,122 ^d	
P4	38,22 ± 0,203 ^e	

Different alphabets showed significant difference at 5%, the same alphabets showed the difference is not significant at 5%.

Total Flavonoid

Adding kapok honey significantly improves the total flavonoid contents (P < 0.05). The total flavonoid increase parallels to the rising Kapok Honey concentrations (Table III). The total flavonoid content in various formulas of the Goat's milk kefir with the addition of kapok honey was 0.011%, 0.019%, 0.021%, 0.026% and 0.026%, respectively. Formula P0 has the lowest total flavonoids. The flavonoid content in P0 comes from the fermentation process by lactic acid bacteria, which turns sugars into phenolic compounds (17).

Table III: Analysis of Total Flavonoids

Formula	Mean (±) SD	P (value)
P0	0,011 ± 0,0003 ^a	<0,001
P1	0,019 ± 0,0003 ^b	
P2	0,021 ± 0,0003 ^c	
P3	0,026 ± 0,0003 ^d	
P4	0,026 ± 0,0003 ^d	

Different alphabets showed significant difference at 5%, the same alphabets showed the difference is not significant at 5%.

Total Phenolic

The addition of kapok honey had a significant effect (P < 0.05) on the total phenolics content (Table IV). The total phenolics content from Goat's milk kefir with the addition of kapok honey were 0.034%, 0.051%, 0.054%, 0.055% and 0.059% for formula P0, P1, P2, P3 and P4 respectively.

Table IV: Analysis of Total Phenolic

Formula	Mean (±) SD	P (value)
P0	0,034 ± 0,000 ^a	<0,001
P1	0,051 ± 0,000 ^b	
P2	0,054 ± 0,000 ^c	
P3	0,055 ± 0,001 ^c	
P4	0,059 ± 0,000 ^d	

Different alphabets showed significant difference at 5%, the same alphabets showed the difference is not significant at 5%.

Lactose Content

Adding kapok honey to Goat's milk kefir resulted in the following lactose concentrations: 3.43%, 3.09%, 3.04%, 2.71%, and 2.46% in formula P0 to P4, respectively (Table V).

Table V: Lactose Content Analysis

Formula	Mean (±) SD	P (value)
P0	3,43 ± 0,05 ^a	<0,001
P1	3,09 ± 0,03 ^b	
P2	3,04 ± 0,05 ^b	
P3	2,71 ± 0,03 ^c	
P4	2,47 ± 0,04 ^d	

Different alphabets showed significant difference at 5%, the same alphabets showed the difference is not significant at 5%.

DISCUSSION

Antioxidant Activity

Kefir and yoghurt have the highest antioxidant activity compared to other fermented products due to probiotic strains such as Lactobacillus casei or Acidophilus (18). It means that pure kefir already has a relatively high antioxidant activity because of its large number of bioactive peptides with low molecular weight (<5000 kDa) produced by lactic acid bacteria and yeast (19).

The addition of Kapok honey improves the antioxidant

capacity of the Kefir. Previous research found similar findings that the addition of honey has a significant effect in increasing the antioxidant activity of Goat's milk kefir, and this increase is parallel to the Kapok honey concentrations (20). The phenolic and flavonoid compounds in Kapok honey causes an increase in the antioxidant activity (21). Other Antioxidant compounds found in honey include vitamin C (0.034%) (22), catalase, and peroxide (23). The antioxidant activity of kapok honey is about IC50 of 16.83 ppm. This finding shows that kapok honey has a strong antioxidant activity (24). Therefore, our study adds to the evidence that adding Kapok honey to Goat's milk kefir consistently improves the Kefir's antioxidant activity.

Total Flavonoid

Flavonoid levels were measured based on the presence of quercetin in honey, the value was expressed as mg quercetin equivalent per 100 grams of honey (mg QE/100 g). The total flavonoids in Goat's milk kefir increased with the addition of kapok flower honey. Previous research stated that flavonoid content in kapok honey has an average total flavonoid of 47.25 mg QE/100 g (9). Therefore, as the concentration of added honey increases, the total flavonoids contained in the Kefir and Honey mix will also increase. Apart from increasing the total flavonoids in Goat's milk kefir, the addition of kapok honey can increase the calories. Honey is a food that consists of 80% simple carbohydrates which are easily digested (fructose and glucose), while the remaining 20% is composed of water, protein, vitamins, and minerals (25). Foods with high sugar levels is an easy to access brain energy source. It will increase tryptophan transport across the blood-brain barrier, thus making it useful for serotonin synthesis (26).

Previous findings regarding fermentation and hydrolysis of complex enzymes to increase the total dissolved phenolic content of flavonoid aglycones explained that antioxidant activity increases due to the solubility of the phenolic compounds found, such as kaempferol and quercetin (27). The increase in flavonoid levels in fermented products could be caused by the activity of lactic acid bacteria. The lactic acid fermentation process produces enzymes that break down sugars, degrade complex phenolic compounds, and release them from the substrate, thereby increasing the availability of phenolic groups to form flavonoid compounds (28).

Total Phenolic

Phenolic content was measured based on the presence of gallic acid in phenolic compounds using the Folin-Ciocalteu method. The reaction of Folin-Ciocalteu with phenolic compounds will form a yellow color, then it will turn blue when reacted with sodium carbonate. The higher the phenolic content in the sample, the more visually the blue color formed will be more intense.

The phenolic content found in P0, comes from the

fermentation process. The fermentation increases biological activity and produces bioactive components such as phenolics compounds. In the fermentation process, lactic acid bacteria produce the enzyme β -glucosidase. The β -glucosidase enzyme will hydrolyse glucosides into aglycones, which increase the free polyphenols concentration (29). Adding kapok honey to samples P1 to P4 resulted in higher total phenolic concentrations in parallel to the increasing kapok honey concentration. Therefore, this increase can largely be associated with kapok honey, which has an average total phenolic content of 309.12 mg GAE/100 g (9).

Our findings align with previous findings regarding mobilising polyphenol antioxidants in apple fibre (30). The addition of Kapok Honey results in increased reduction power of dissolved phenolics, increased antioxidant activity and inhibitory effectiveness against α -glucosidase, and the hydrolysing enzymes increase the positive effects of fermentation (27).

Lactose Content

Increasing the concentrations of Kapok honey significantly lowers lactose levels. Kefir's microbes hydrolyse this due to lactose in Goat's milk for fermentation and becoming a source of nutrition for bacterial growth. One research stated that the fermentation at room temperature reduces the lactose content from 5.17% to 1.63% (31).

Lactose is an energy source for microorganisms such as lactic acid bacteria (14). The first component fermented is carbohydrates, then protein, and finally fat. These components are broken down into simpler compounds. Lactose is broken down by *Streptococcus* and *Kluyveromyces* strains with the help of the lactase enzyme into glucose and galactose, then glycolysis to produce lactic acid, CO₂, and alcohol (32).

Previous research stated that increasing sugar concentration in honey could increase the number of lactic acid bacteria (33). So, it will break down lactose faster and lower the lactose level in Kefir. The five formulas (P0, P1, P2, P3, and P4) have different milk concentrations. From P0 to P4 respectively, the milk concentration used decreases, while the concentration of kapok honey increases. So, the results obtained that adding a greater concentration of kapok honey would reduce the lactose content in goat's milk kefir. As in previous research, yoghurt drinks contain higher longan fruit extract have lower lactose concentration (34).

Fermented Goat's milk kefir with Kapok flower honey produces a low-lactose fermented milk product with high bioactive components. Previous research showed that the lactose in Goat's milk kefir is 2.64%, which is categorised as low lactose (35). Low-lactose dairy products lower the risk of gastrointestinal problems in people with lactose intolerance such as diarrhoea, abdominal pain, flatulence (29).

CONCLUSION

The addition of Kapok Honey to Goat's milk Kefir improves its quality, marked by an increase in total flavonoids, phenolics and antioxidant activity. On the other hand, the lactose levels in Goat's milk kefir decreased as the concentration of kapok honey increased. The sample with formula P4 is the best quality sample because it has the highest bioactive components and lowest lactose content; this quality showed that the Goat's milk kefir added with 25% Kapok Honey has the highest potential as a functional food.

ACKNOWLEDGEMENT

The author expresses gratitude to UPN Veteran Jakarta for providing a research grant for a Scopus-based research scheme with contract number 090/UN61.4/LIT.RISOP/2024.

REFERENCES

1. O'Brien K V., Aryana KJ, Prinyawiwatkul W, Ordonez KMC, Boeneke CA. Short communication: The effects of frozen storage on the survival of probiotic microorganisms found in traditionally and commercially manufactured kefir. *J Dairy Sci.* 2016 Sep 1;99(9):7043–8. DOI: 10.3168/jds.2015-10284
2. Nurhayati Y. Analisa TPC, Bakteri Asam Laktat, dan Daya Simpan Masker Kefir Susu Kambing. [Kediri]: Universitas Nusantara PGRI Kediri; 2016.
3. Yurliasni Y, Hanum Z, Hikmawan R. Analysis of Honey Addition to Improve Kefir Drink Qualities. *Jurnal Ilmu dan Teknologi Hasil Ternak.* 2019 Apr 1;19(1):50–9. DOI: 10.21776/ub.jitek.2019.014.01.6
4. Rohmah F, Estiasih T. Perubahan Karakteristik Kefir Selama Penyimpanan. *Jurnal Pangan dan Agroindustri.* 2018;6(3):30–6. <https://doi.org/10.21776/ub.jpa.2018.006.03.4>
5. Muntafiah A, Sunarti, Nurliyani. Potensi Anti Hiperglikemia Kefir Berbasis Susu Kambing dan Kedelai Pada Tikus Model DM Tipe 2. *Mandala Health.* 2015;8(3):612–21. <https://doi.org/10.20884/1.mandala.2017.8.1.349>
6. Hilmi M, Abdul Wahid M, Habbib Khirzin M, Fajar Thriesnanda Y. Pelatihan Pengolahan Susu Kambing Etawa Menjadi Kefir di Kecamatan Kalipuro Kabupaten Banyuwangi. *E-Dimas: Jurnal Pengabdian kepada Masyarakat.* 2022;13(3):402–7. <https://doi.org/10.26877/e-dimas.v13i3.4177>
7. Suhandy D, Yulia M, Kusumiyati. Klasifikasi Madu Berdasarkan Jenis Lebah (*Apis dorsata* versus *Apis mellifera*) Menggunakan Spektroskopi Ultraviolet dan Kemometrika. *Jurnal Ilmu Pertanian Indonesia.* 2020 Oct 27;25(4):564–73. DOI: 10.18343/jipi.25.4.564
8. Triwanto J, Herlinda K, Muttaqin T. Kualitas Fisikokimia Pada Madu dari Nektar Bunga Randu (*Ceiba pentandra*) dan Kaliandra (*Calliandra calothyrsus*). *Journal of Forest Science Avicennia.* 2022 Feb 2;4(2):102–13. DOI: 10.22219/avicennia.v4i2.19750
9. Ustad U, Radiati L, Thohari I. KOMPONEN BIOAKTIF PADAMADU KARET (*Hevea brasiliensis*) MADU KALIANDRA (*Calliandra calothyrsus*) DAN MADU RANDU (*Ceiba pentandra*). *Jurnal Ilmu dan Teknologi Hasil Ternak.* 2017 Nov 1;12(2):97–102. DOI: 10.21776/ub.jitek.2017.012.02.6
10. Wulandari A, Purwadi P, Jaya F. Coffee Flower Honey (*Coffea sp.*) Addition to Kefir Quality Based on Microbiology Characteristic. *Jurnal Ilmu dan Teknologi Hasil Ternak.* 2017 Nov 1;12(2):83–8. DOI: 10.21776/ub.jitek.2017.012.02.4
11. Maryam S. KADAR ANTIOKSIDAN DAN IC 50 TEMPE KACANG MERAH (*Phaseolus vulgaris* L) YANG DIFERMENTASI DENGAN LAMA FERMENTASI BERBEDA. In: *Proceedings Seminar Nasional FMIPA UNDIKSHA V.* 2015. p. 347–52. Available at: <https://ejournal.undiksha.ac.id/index.php/semnasmipa/article/view/10303>
12. Lindawati SA, Sriyani NLP, Hartawan M, Suranjaya IG. STUDY MIKROBIOLOGIS KEFIR DENGAN WAKTU SIMPAN BERBEDA. *Majalan Ilmiah Peternakan.* 2015;18(3):95–9. <https://doi.org/10.24843/MIP.2015.v18.i03.p03>
13. Setyawardani T, Sumarmono J. Chemical and Microbiological Characteristics of Goat Milk Kefir During Storage Under Different Temperatures. *Journal of the Indonesian Tropical Animal Agriculture (J Indonesian Trop Anim Agric).* 2015;40(3):183–8. <https://doi.org/10.14710/jitaa.40.3.183-188>
14. Septiani NKA, Parwata IMO, Putra AAB. PENENTUAN KADAR TOTAL FENOL, KADAR TOTAL FLAVONOID DAN SKRINING FITOKIMIA EKSTRAK ETANOL DAUN GAHARU (*Gyrinops versteegii*). *Wahana Matematika dan Sains: Jurnal Matematik, Sains, dan Pembelajarannya.* 2018;12(1):78–89. <https://doi.org/10.23887/wms.v12i1.13868>
15. Nelson N. A photometric adaptation of the Somogyi method for the determination of glucose. *J Biol Chem.* 1994;153(2):375–80. [https://doi.org/10.1016/S0021-9258\(18\)71980-7](https://doi.org/10.1016/S0021-9258(18)71980-7)
16. Primurdia EG, Kusnadi J. AKTIVITAS ANTIOKSIDAN MINUMAN PROBIOTIK SARI KURMA (*Phoenix dactylifera* L.) dengan ISOLAT *L. Plantarum* dan *L. casei*. *Jurnal Pangan dan Agroindustri.* 2014 Jul;2(3):98–109. <https://jpa.ub.ac.id/index.php/jpa/article/view/57>
17. Stobiecka M, Kryl J, Brodziak A. Antioxidant Activity of Milk and Dairy Products. *Animals.* 2022 Feb 1;12(3):1–27. DOI: 10.3390/ani12030245
18. Perna A, Simonetti A, Gambacorta E. Phenolic content and antioxidant activity of donkey milk kefir fortified with sulla honey and rosemary

- essential oil during refrigerated storage. *Int J Dairy Technol.* 2019 Feb 1;72(1):74–81. DOI: 10.1111/1471-0307.12561
19. Hardiansyah A, Kusuma HH. OPTIMALISASI KUALITAS ORGANOLEPTIK DAN AKTIVITAS ANTIOKSIDAN KEFIR SUSU KAMBING DENGAN PENAMBAHAN MADU LOKAL BUNGA RANDU. *Journal of Nutrition College.* 2022;11(4):278–84. <https://doi.org/10.14710/jnc.v11i4.34506>
 20. Kiessoun K, Souza A, Meda NTR, Coulibaly AY, Kiendrebeogo M, Lamien-Meda A, et al. Polyphenol Contents, Antioxidant and Anti-Inflammatory Activities of Six Malvaceae Species Traditionally used to Treat Hepatitis B in Burkina Faso. *European Journal of Scientific Research.* 2010;44(4):570–80. Available at: <https://www.researchgate.net/publication/292013028>
 21. Budiarti A, Sumantri, Istyaningrum DF. EVALUASI KANDUNGAN VITAMIN C DALAM MADU RANDU DAN MADU KELENGKENG DARI PETERNAK LEBAH DAN MADU PERDAGANGAN DI KOTA SEMARANG. *Jurnal Ilmu Farmasi dan Farmasi Klinik.* 2012;9(2):10–5. <http://dx.doi.org/10.31942/jiffk.v9i2.865>
 22. Wulansari DD. Madu: Sebagai Terapi Komplementer. Yogyakarta: Graha Ilmu; 2018.
 23. Tristantini D, Ismawati A, Tegar Pradana B, Gabriel Jonathan J. Pengujian Aktivitas Antioksidan Menggunakan Metode DPPH pada Daun Tanjung (*Mimusops elengi* L). *Prosiding Seminar Nasional Teknik Kimia “Kejuangan.”* Yogyakarta; 2016. Available at: <http://jurnal.upnyk.ac.id/index.php/kejuangan/article/view/1547>
 24. Almasaudi S. The Antibacterial Activities of Honey. *Saudi J Biol Sci.* 2021 Apr 1;28(4):2188–96. DOI: 10.1016/j.sjbs.2020.10.017
 25. Çoşkun F, Erol H. The Quality of Kefir with Honey and with Banana Enriched with Almond Milk. *Turkish Journal of Agriculture - Food Science and Technology.* 2023 Aug 31;11(8):1337–44. <https://doi.org/10.24925/turjaf.v11i8.1337-1344.6007>
 26. Wang L, Luo Y, Wu Y, Liu Y, Wu Z. Fermentation and complex enzyme hydrolysis for improving the total soluble phenolic contents, flavonoid aglycones contents and bio-activities of guava leaves tea. *Food Chem.* 2018 Oct 30;264:189–98. DOI: 10.1016/j.foodchem.2018.05.035
 27. Dwiputri MC. Pengaruh lama fermentasi terhadap total asam tertitiasi, total flavonoid dan aktivitas antioksidan kombucha bunga telang (*Clitoria ternatea* L.) [Skripsi]. [Yogyakarta]: Universitas Sanata Dharma; 2018. Available at: <http://repository.usd.ac.id/id/eprint/31605>
 28. Limón RI, Peñas E, Torion MI, Martínez-Villaluenga C, Dueñas M, Frias J. Fermentation enhances the content of bioactive compounds in kidney bean extracts. *Food Chem.* 2015;172:343–52. <https://doi.org/10.1016/j.foodchem.2014.09.084>
 29. Ajila CM, Gassara F, Brar SK, Verma M, Tyagi RD, Valéro JR. Polyphenolic Antioxidant Mobilization in Apple Pomace by Different Methods of Solid-State Fermentation and Evaluation of Its Antioxidant Activity. *Food Bioproc Tech.* 2012 Oct 3;5(7):2697–707. <https://doi.org/10.1007/s11947-011-0582-y>
 30. Nursiwi A, Utami R, Andriani M, Sari AP. Fermentasi whey limbah keju untuk produksi kefir oleh kefir grains. *Jurnal Teknologi Hasil Pertanian.* 2015;8(1):37–45. <https://doi.org/10.20961/jthp.v0i0.12794>
 31. Anggraini PD, Suryani T. Kualitas Kefir Komposisi Sari Kedelai dan Susu Skim Dengan Variasi Konsentrasi Starter dan Lama Fermentasi. *Artikel Pemakalah Paralel.* 2019;194–9.
 32. Haryadi, Nurliana, Sugito. Nilai pH dan jumlah bakteri asam laktat kefir susu kambing setelah difermentasi dengan penambahan gula dengan lama inkubasi yang berbeda. *Jurnal medika veterinaria.* 2013;7(1):4–7. <https://doi.org/10.21157/j.med.vet.v7i1.2905>
 33. Kumalasari KED, Legowo AM, Al-Baarri AN. Total Bakteri Asam Laktat, Kadar Laktosa, pH, Keasaman, Kesukaan Drink Yogurt dengan Penambahan Ekstrak Buah Kelengkeng. *Jurnal Aplikasi Teknologi Pangan.* 2013;2(4):165–8. Available at: <https://proceedings.ums.ac.id/index.php/snpbs/article/view/754>
 34. Hardiansyah A. Identifikasi Nilai Gizi dan Potensi Manfaat Kefir Susu Kambing. *JOURNAL OF NUTRITION COLLEGE.* 2020;9(3):208–14. <https://doi.org/10.14710/jnc.v9i3.27308>