

Quality change of goat milk kefir with the addition of butterfly pea flower powder when stored in low temperatures

*Setyawardani, T., Sumarmono, J., Rahardjo, A.H.D., Santosa, S.S. and Arkan, N.D.

Faculty of Animal Science, Jenderal Soedirman University, Jl. Dr. Soeparno No. 60 Karangwangkal, Purwokerto - Indonesia

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Abstract

Kefir made from goat milk with the addition of butterfly pea flower powder is one of the innovations in product development. The study aimed to investigate the quality changes of goat milk kefir enriched with different concentrations of butterfly pea flower powder (0, 0.5, 1.0, and 1.5%) during storage at low temperatures for 0, 3, 6, 9, and 12 days. The results showed that kefir antioxidant activities were significantly affected by the additional percentage of butterfly pea flower powder as compared to those without treatment. The average antioxidant activities were 1.55-16.63 (% B/W) DPPH, and these were not affected by cold storage for up to 12 days. Kefir with a higher percentage of butterfly pea flower powder showed less brightness of the kefir colour. Score a* (red-green) of kefir in this study was 8.996-15.36, which increased with the percentage of butterfly pea flower powder and storage duration. Score b* showed a significant difference between kefir with and without the addition of butterfly pea flower powder. The nutritional value (protein and fat) of kefir added with butterfly pea flower powder was lower compared to kefir without treatment. The ash content increased with the additional percentage of butterfly pea flower powder. Acidity expressed as the titratable acidity (TAT) of kefir was relatively similar (1.25-1.40) in kefir with or without additional percentages of butterfly pea flower powder and stored for different days. The average water content of kefir added with different percentages of butterfly pea flower was 84.59%, and different durations of cold storage resulted in 84.58% water content. The overall activity of kefir added with butterfly pea flower was 0.84. Kefir added with butterfly pea flower powder and stored for different days contained relatively similar total lactic acid bacteria count (4.0×10^4 - 5.0×10^7) and yeast count ($<1 \times 10^1$ - 1.8×10^5). Conclusively, kefir added with up to 1.5% butterfly pea flower powder showed increased levels of antioxidant activities, colour brightness, and ash content. Different durations of cold storage and the interactions resulted in similar contents.

1. Introduction

Demand for functional food is experiencing an upward trend as people have increased awareness of healthy food, including kefir. Kefir is a probiotic drink made of kefir grain that potentially improves health (Ganatsios *et al.*, 2021). The microorganisms of kefir grain consist of multiple lactic acid bacteria (LAB) and yeast in polysaccharide matrices, which play a role as a fermentation starter. Heterofermentative lactic acid bacteria produce metabolites in the form of lactic acid, acetate and CO₂, and yeast produce ethanol. The synergy of LAB and yeast produces a product with distinctive characteristics. The composition of kefir grains derived from Indonesia is mostly LAB, such as *Lactobacillus*

fermentum 1, *Lactobacillus brevis* 3, *Lactobacillus paracasei* ssp. *paracasei*, and *Lactococcus lactis* sp. *Lactis*. Meanwhile, most species of yeast are *Saccharomyces cerevisiae*, *Candida krusei/inconspicua*, *Candida parasitopsis*, *Candida glabrata* and *Kloeckera* spp. Lactic acid bacteria and yeast have different capacities to acidify and thicken milk (Yusuf *et al.*, 2020).

Butterfly pea flower is a source of rich antioxidants. Numerous studies have reported different mechanisms of antioxidants to capture free radicals in order to relieve oxidative stress in biological systems, such as inhibiting oxidative enzymes, chelating iron ions, and serving as the cofactors of antioxidant enzymes (Karadag *et al.*,

*Corresponding author.

Email: [triana.setyawardani@unsoed.ac.id](mailto: triana.setyawardani@unsoed.ac.id)

2009; Birben *et al.*, 2012). Butterfly pea flowers are extracted by either boiling, macerating, or brewing. The highest levels of phenolic and flavonoid contained in butterfly pea leaves are 57.51 mg GAE/g and 1.50 mg EK/g, respectively. It is reported that boiling butterfly pea flower can produce the highest level of flavonoid (0.88 EK/g) (Purwanto and Aprilia, 2022).

Accordingly, kefir added with antioxidant-rich butterfly pea flower powder will be antioxidant-enriched kefir with natural colouring from the flower. In the food industry, anthocyanin is commonly used as a natural colouring agent in the form of powder or concentrate. Ice cream, yogurt, and jam are some manufactured products that use anthocyanin (Sugiarto *et al.*, 2022).

The acidity level of kefir is derived from the metabolites of different acids produced during fermentation, including lactic acid, acetic acid, pyruvic acid, hippuric acid, propionic acid, diacetyl acid, and acetaldehyde acid. Metabolite produces flavor and aroma of kefir (Ahmed *et al.*, 2013). This present study will investigate the effect of incorporating up to 1.5% butterfly pea flower powder into kefir making and the impact of shelf life in cold storage on the quality of goat milk kefir.

2. Materials and methods

2.1 Sample preparation and storage

Kefir samples were created with different concentrations of butterfly pea flower powder with the following treatment A0: kefir without the addition of butterfly pea flower powder; A1: kefir with the addition of 0.5% butterfly pea flower powder; A2: kefir with the addition of 1% butterfly pea flower powder; A3: kefir with the addition of 1.5% butterfly pea flower powder; B0: kefir of butterfly pea flower without cold storage; B1: kefir butterfly pea flower in 3-day of cold storage; B2: kefir butterfly pea flower in 6-day of cold storage; B3: kefir butterfly pea flower in 9-day of cold storage; and B4: kefir butterfly pea flower in 12-day of cold storage. The chemical composition, including protein, fat, and ash content, of the kefir samples, with and without butterfly pea flower extract, was then evaluated using the AOAC method. The antioxidant activities, color, lactic acid bacteria (LAB) and yeast content, pH value, and water activity of the kefir were measured.

2.2 Chemical composition of kefir

The chemical composition of kefir, with or without butterfly pea flower extract, was evaluated using the Association of the Official Analytical Collaboration (AOAC) International method (2005) for protein, fat, and ash contents.

2.3 Antioxidant activity

Antioxidant activity of the kefir sample was measured with the DPPH method according to Payet *et al.* (2005). To make the extract, exactly 0.2 g of sample was added with 5 mL of methanol, then extracted, and 0.2 mL of the solution (the extract) was isolated. This extract was added with 2.8 mL of 0.1 mM DPPH reagent. The sample was incubated at room temperature in a dark room for 30 mins, then subjected to test using a spectrophotometer at 517 nm λ . A similar procedure was applied to blank solutions made by adding 0.2 mL of methanol with 2.8 mL of 0.1 mM DPPH reagent and tested with a spectrophotometer at the same wavelength. The results were integrated into the formula as follows:

$$\% \text{ resistance} = \frac{\text{Blank absorbent test} - \text{Sample absorbent test}}{\text{Blank absorbent test}} \times 100$$

2.4 Colour measurement

The colour of kefir was tested using a digital colourimetry (CS-10, CHNSpec, China) according to Astuti *et al.* (2021). Exactly 30 mL of the kefir sample was put into a 30 mL Erlenmeyer flask and then tested with the colourimetry. The obtained scores were a^* , b^* and WI^* (*White Index*) calculated with the formula of $WI = ((100 - L^*2) + a^*2 + b^*2) / 2$.

2.5 Lactic acid bacteria and yeast count

Approximately 1 mL of sample was added with 9 mL 0.9% NaCl solution, homogenized, and put into a tube for gradual dilution. The dilution was conducted by calculating total LAB up to 10^6 and 10^4 for the total yeast using the *pour plate* method. Then, 1 mL of dilutions 10^4 , 10^5 , and 10^6 was added with MRSA (Merck) for the total LAB cultivation, and PDA (Oxoid, UK) for yeast cultivation. The petri dish containing the sample and media was incubated for 48 hrs for LAB and 24 hrs for total. The number of LAB and yeast was calculated according to Bacteriological Analytical Manual (BAM) (2001) with the following formula:

$$N = \frac{\sum c}{[(1 \times n_1) + (0.1 \times n_2)] \times (d)}$$

Where N = Number of colonies per mL or g of product, $\sum c$ = Sum of all colonies on all plates counted, n_1 = Number of plates in first dilution counted, n_2 = Number of plates in second dilution counted and d = Dilution from which the first counts were obtained

2.6 pH value and Aw measurement

The pH value was measured with a digital pH meter, and Aw was measured with an Aw meter.

2.7 Statistical analysis

The results of incorporating butterfly pea flower powder (A0, A1, A2, and A3) and storing kefir in different shelf lives (B0, B1, B2, B3, and B4) were subject to analysis of variance (ANOVA). Any significant difference resulting from ANOVA was subject to the Duncan test using SPSS ver. 25.

3. Results and discussion

3.1 Antioxidant activities of kefir

Figure 1 shows that different percentages of butterfly pea flower powder added to kefir have increased the antioxidant activities of kefir. Incorporating 1.5% of butterfly pea flower powder could significantly increase antioxidant levels ($P < 0.05$) compared to non-supplemented kefir, which ranged from 1.55 to 16.36 (% b/b) calculated with DPPH. The highest activity score was observed with the addition of 1.5% of butterfly pea flower into kefir, showing antioxidant activities of 16.36 (% b/b). Butterfly pea flower exhibits antioxidant activities of 11.97 (% b/w) (Lakshan *et al.*, 2020). The duration of cold storage of up to 12 days did not affect the antioxidant activities in kefir.

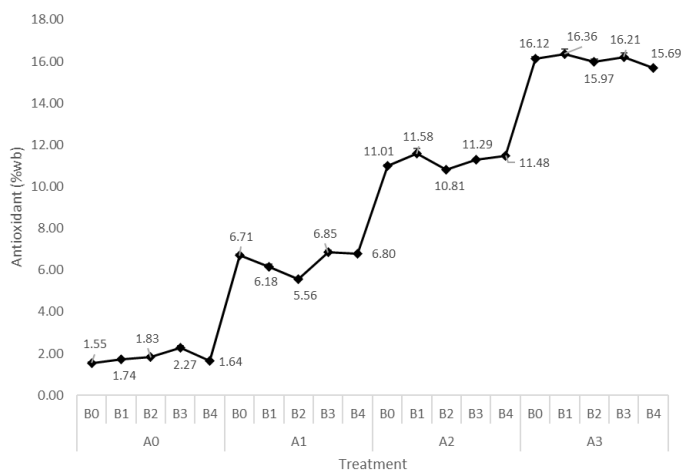


Table 2. Average total LAB and yeast kefir butterfly pea flower during cold storage.

Butterfly pea flower is a source of flavonoids and contains antioxidant properties that are good for food products (Makasana *et al.*, 2017). In addition, the butterfly pea flower also exhibits antimicrobial properties, which benefit health, and the flower has been incorporated into functional food (Jeyaraj *et al.*, 2021).

Previous studies have reported antioxidant activities of yogurt made from different types of milk (fresh skim milk, UHT milk, pasteurized milk, UHT + skim milk, and pasteurized milk + skim milk) and added with 10% (v/v) extract of butterfly pea flower. The results showed that yogurt added with the extract of butterfly pea flower had a higher antioxidant activity than the control group (Sutakwa *et al.*, 2021).

The fermentation process can improve antioxidant activities due to the increase of phenolic and flavonoid compounds during the fermentation, which results from microbial hydrolysis. Additionally, the fermentation process can induce structural damage to the plant cell wall, which leads to the release or synthesis of antioxidant activity. Antioxidant activities play a role in capturing free radicals, iron binding, oxygen sequencing, or donating radical hydrogen (Hur *et al.*, 2014). Fermentation could increase antioxidant activities as a result of the increased phytochemicals, antioxidant polysaccharides, and antioxidant peptides produced from microbial hydrolysis or biotransformation. Further, fermentation can stimulate the degradation of the plant cell wall, which helps release or produce different antioxidant compounds. In general, the results showed that fermentation contributes to an increase in the content and capacities of antioxidants (Zhao *et al.*, 2021).

3.2. Kefir colour

Table 1 shows that the higher the addition of butterfly pea flower powder, the greater the impact it imposed on score a* (8.996-15.366), and storage or shelf life significantly affected ($P < 0.05$) score a* (red-green). Kefir contained an average pH of 4.16, which gave out a bluish to purplish colour. According to Nikijuluw (2013), the extract of butterfly pea flower had a vast colour spectrum, such as red at pH 1-2, purplish to bluish at pH 3-7 and yellow to green at pH 8-14. The best blue colour can be retained from pH 1-12. The colour score of the extract of butterfly pea flower of 4.5 and 7 show bluish to purplish colour. When incorporated into yogurt drink (pH 4.5) it turned bluish-purple.

Anthocyanin in *Clitoria ternatea* is a stable pigment in acid conditions. These components should be circumvented from light, oxygen, cold temperature, and oxidase polyphenol enzymes because anthocyanine is a natural colouring agent as well as an antioxidant due to its reactive structure (Nurtiana, 2019).

Score b* shows a yellow-blue colour, which is indicative of a significant difference from kefir without the addition of butterfly pea flower powder. The pH score is one of the contributing factors to score b*, in which the higher the pH (3-7) the bluer the colour, and the anthocyanin component is a stable pigment in acid conditions. The extract of butterfly pea flower shows bluish purple at pH 4, purplish blue at pH 5, and light blue at pH 6 (Sugiarto *et al.*, 2022).

Score L* shows the light or dark intensity of a material. The results of the present study show that the higher the percentage of butterfly pea flower powder incorporated into kefir, the lower the lightness of the

Table 1. Colour, composition and titratable acidity of kefir with or without butterfly pea flower powder.

Characteristics	Percentage	Cold Storage (days)					Average	Significance		
		B0	B1	B2	B3	B4		P	S	P×S
a*	A0	7.97	5.21	11.05	7.88	12.87	8.996	*	*	ns
	A1	10.89	15.04	21.91	15.9	10.61	14.87			
	A2	12.42	14.87	19.45	14.88	13.79	15.082			
	A3	16.26	15.2	14.1	16.37	14.9	15.366			
Average		11.89	12.58	16.63	13.76	13.04				
b*	A0	18.43	18.5	11.41	15.96	13.58	15.576			
	A1	-3.54	-7.71	-8.45	-2.71	1.95	-4.092	*	*	ns
	A2	-2.52	-3.36	-1.07	-1.84	-0.24	-1.806			
	A3	-1.09	-3.77	-1.47	-1.5	-1.52	-1.87			
Average		0.92	0.11	2.48	3.44	1.95				
L*	A0	49.27	51.91	48.69	44.73	44.47	47.814	*	ns	ns
	A1	32.5	33.13	30.49	28.54	36.42	32.216			
	A2	27.18	23.37	25.52	21.99	26	24.812			
	A3	26.57	26.67	21.02	18.6	26.5	23.872			
Average		33.77	31.43	28.47	33.34	32.18				
Protein (%)	A0	5.71	5.06	5.81	5.62	5.43	5.53	*	*	ns
	A1	4.74	4.85	4.83	4.43	5.20	4.81			
	A2	5.02	4.57	5.49	5.01	5.36	5.09			
	A3	4.77	5.51	4.80	4.63	4.51	4.84			
Average		5.00	5.23	4.92	5.12	5.06				
Fat (%)	A0	2.13	2.59	2.29	1.97	3.27	2.45	*	*	ns
	A1	2.18	1.39	2.05	1.72	1.70	1.81			
	A2	1.88	1.10	2.62	2.29	2.92	2.16			
	A3	2.28	2.04	1.57	0.81	1.98	1.73			
Average		1.78	2.13	1.69	2.47	2.11				
Ash (%)	A0	0.98	0.90	1.02	1.01	0.96	0.97	*	*	ns
	A1	0.99	0.965	0.97	0.99	0.97	0.98			
	A2	0.99	1.02	1.02	0.50	1.01	0.91			
	A3	0.98	0.99	1.02	1.00	0.97	0.99			
Average		0.97	1.01	0.87	0.98	0.98				
TAT (%)	A0	1.29	1.20	1.16	1.16	1.42	1.25	ns	ns	ns
	A1	1.77	2.23	1.94	1.77	1.95	1.93			
	A2	2.47	2.08	1.76	2.17	2.55	2.21			
	A3	2.54	2.44	2.60	2.31	2.11	2.40			
Average		2.02	1.99	1.87	1.85	2.01	1.95			

*: significantly different, ns: not significant

kefir in a significant difference ($P < 0.05$). The range of the L^* score was 47.81 to 23.87; the higher the L^* score, the lighter the kefir colour. Kefir is a fermentation product which has a pH of 4.16, thus acid pH. Kefir without the addition of butterfly pea flower powder had the highest L^* score or the highest brightness. Meanwhile, the L^* score for butterfly pea flower extract is 25.62-74.13 (Nikijuluw, 2013).

3.3 Chemical composition and titratable acidity of kefir

The nutrition of kefir added with butterfly pea flower powder showed a decrease in protein and fat compared

to kefir without the addition of butterfly pea flower powder ($P < 0.05$). This result was in agreement with a previous study (Ali *et al.*, 2014), which reported a decreasing amount of protein and fat in fermented products made of camel's milk. The storage process and additional percentage of butterfly pea flower powder would produce ash in significantly different amounts ($P < 0.05$). In general, ash content increases with the percentage of additional butterfly pea flower powder. This result was contrary to that reported in a previous study (Ali *et al.*, 2014) of fermented camel milk, in which the fermentation decreased the total ash.

The acidity value was calculated as titratable acidity (TAT) in a range of 1.25-1.40 and was not significantly different between kefir with and without butterfly pea flower powder and across different shelf lives.

In fermentation products, the relation between titratable acidity and pH is crucial. TA and pH were measured during the fermentation process. The contributing factors in this process were TA, pH concentration, and the solid produced pH 4.4. It is a mechanical reaction that plays a role in the characteristics of antioxidant milk, related to multiple bioactive peptides that exist naturally in milk or are released during the fermentation process (Tomovska *et al.*, 2016).

3.4 Total lactic acid bacteria and yeast of kefir

Table 2 demonstrates that the total lactic acid bacteria (LAB) with or without the addition of kefir butterfly pea flower powder were 6.0×10^4 to 5.0×10^7 . The highest average of total LAB was observed in the addition of 1.5% of butterfly pea flower powder (2.3×10^7), while the highest average yeast of kefir without the addition of butterfly pea flower powder was 4.1×10^3 . The highest lactic acid bacteria were observed in kefir added with 1.5% butterfly pea flower powder, stored for 12 days 4.8×10^7 . The number of lactic acid bacteria (4.8×10^7) can still maintain their numbers up to 12 days of cold storage. An increase in the amount of yeast also occurred in the treatment with the addition of 1-1.5% butterfly pea flower powder, which was stored for 12 days of cold storage. The amount of yeast counted was smaller than the number of LAB. This indicated that in kefir butterfly pea flower, the microbes in the LAB group dominated, while yeast was only detected in relatively small amounts. Stress due to cold temperatures induces CSPs (Cold shock Proteins) (Wouters *et al.*, 2000). All CSPs are present in low molecular weight proteins. The protein binds to a single nucleic acid strand and forms a secondary structure at low temperatures. CPSs support transcription and translation processes in cold stress. Cold temperatures above freezing temperatures can stop LAB growth, but it takes time for cell death so many LAB can be stored at low temperatures (0°C) for a few days (Papadimitriou *et al.*, 2016).

Research using KLDS 1.0628 cells showed that under cold stress, the pre-adaptation process to sub-lethal levels of stress could increase cell viability after being given heat treatment compared to controls (Ma *et al.*, 2021). The percentage increased along with the 12-day storage time, which resulted in a higher amount of yeast. This shows that at 12 days of cold storage, butterfly pea flower kefir has a high LAB and yeast population. Kefir

is produced using kefir grains as a starter, which consists of a polysaccharide matrix containing various types of LAB and yeast, which are synergistic. Lactic acid bacteria make kefir taste sour, and yeast plays a role in producing ethanol, which is a characteristic of kefir drinks. At the beginning of kefir production, acidic LAB lowers the pH of milk to become acidic, then LAB will grow and utilize milk media, especially lactose, to be converted into metabolites in the form of lactic acid. Several types of LAB in kefir grains are heterofermentative which produce lactic acid, acetic and CO₂. In the right media conditions for yeast growth, the yeast will grow and develop to produce ethanol, as one of the characteristics of kefir.

Table 2. Average total LAB and yeast kefir butterfly pea flower during cold storage.

Butterfly pea flower powder (%)	Cold Storage (days)	LAB (CFU/mL)	Yeast (CFU/mL)
A0	B0	6.0×10^4	$< 1.0 \times 10^1$
	B1	4.9×10^5	7.5×10^3
	B2	5.4×10^5	1.3×10^4
	B3	9.1×10^5	$< 1.0 \times 10^1$
	B4	3.2×10^5	$< 1.0 \times 10^1$
A1	B0	2.4×10^5	3.9×10^4
	B1	1.2×10^5	$< 1.0 \times 10^1$
	B2	1.6×10^5	1.8×10^4
	B3	4.2×10^5	$< 1.0 \times 10^1$
	B4	1.2×10^5	2.8×10^4
A2	B0	1.2×10^6	$< 1.0 \times 10^1$
	B1	1.1×10^6	1.5×10^4
	B2	9.2×10^5	$< 1.0 \times 10^1$
	B3	2.8×10^6	$< 1.0 \times 10^2$
	B4	9.8×10^6	1.8×10^5
A3	B0	6.0×10^6	$< 1.0 \times 10^1$
	B1	4.1×10^6	$< 1.0 \times 10^1$
	B2	5.0×10^7	1.7×10^4
	B3	5.8×10^6	3.2×10^4
	B4	4.8×10^7	1.2×10^4

Incorporating butterfly pea flower powder could increase the antioxidant activity of the product without giving a significant effect on the amount of LAB and yeast so that there is no change in kefir sensory. Yeast and lactobacilli are interdependent and grow in equal proportions in kefir grains, symbiosis with yeast, *Lactobacillus* and *Streptococcus* occur in the kefir production process (Sarkar, 2008).

3.5 Water content and Aw of kefir

Table 3 shows that kefir with or without the addition of butterfly pea flower up to 1.5% did not produce a

Table 3. Total water content, pH value, and water activities of kefir with or without the addition of butterfly pea flower powder and stored in cold storage.

Characteristics	Percentage	Cold Storage (days)					Average	Significance		
		B0	B1	B2	B3	B4		P	S	P×S
Water Content (%)	A0	83.58±0.32	83.95±1.19	82.98±0.93	85.82±3.89	83.71±3.08	84.01±1.88	ns	ns	ns
	A1	83.51±2.96	85.03±1.59	85.25±2.32	84.90±1.76	85.30±2.02	84.80±2.13			
	A2	83.82±0.76	85.06±1.89	84.14±0.75	85.32±2.68	85.64±1.71	84.80±1.56			
	A3	84.43±1.21	83.86±1.09	83.69±1.92	85.56±1.87	86.15±2.73	84.74±1.77			
pH	A0	4.37±0.31	4.43±0.50	4.70±0.62	4.59±0.50	4.29±0.30	4.47±0.45	ns	ns	ns
	A1	4.26±0.38	3.76±0.58	4.28±0.44	3.91±0.69	4.00±0.26	4.04±0.47			
	A2	3.64±0.32	4.07±0.18	4.37±0.17	4.15±0.43	3.79±0.24	4.00±0.27			
	A3	3.90±0.08	4.11±0.17	4.23±0.25	4.31±0.51	4.02±0.50	4.16±0.30			
aW	A0	0.85±0.01	0.82±0.05	0.83±0.00	0.82±0.01	0.81±0.04	0.83±0.02	ns	ns	ns
	A1	0.84±0.01	0.79±0.03	0.82±0.02	0.82±0.01	0.83±0.03	0.82±0.02			
	A2	0.85±0.01	0.82±0.02	0.83±0.03	0.82±0.00	0.80±0.06	0.82±0.02			
	A3	0.84±0.01	0.85±0.01	0.84±0.02	0.82±0.02	0.83±0.01	0.83±0.01			

ns: not significant

significant difference in water content ($P>0.05$). Cold storage time up to 12 days also did not cause differences in moisture content ($P>0.05$). The average water content ranged from 82.98-86.15%, which was slightly lower than that of cow milk, which was around 87%. The higher the moisture content of the product, in general, will reduce its shelf life. This is not always the case with kefir, because kefir is a fermented product using LAB and yeast to create acidic conditions, so the high water content does not reduce the product's shelf life. The water content obtained is lower than that reported by Setyawardani and Sumarmono (2015), who reported 86-89%, and storage time affects the water content of kefir.

Water activity is the amount of water used by microbes to grow and develop. Table 3 shows that the water activity (Aw) of butterfly pea flower kefir has an average of 0.79-0.85 with different percentages of butterfly pea flower powder and storage time. The Aw value of kefir with or without the addition of butterfly pea flower and storage time was not significantly different ($P>0.05$). These results are in agreement with previous research (Setyawardani and Sumarmono, 2015), which reported that the water activity (Aw) of kefir was not affected by temperature and storage time. The Aw value of kefir with a higher range is 0.875 ± 0.028 units.

3.6 pH value of kefir

The pH value indicates the level of acidity of kefir; the lower the pH, the more acidic the kefir. In general, kefir has a lower pH value than other fermented products because the number and types of microbes present in kefir grains are more diverse.

Kefir contains various LAB, which include *Lactobacillus*, *Lactococcus*, *Leuconostoc*, *Streptococcus*

spp. and yeast, including *Kluyveromyces*, *Saccharomyces* and *Torula* in a polysaccharide matrix (Witthuhn et al., 2005; Magalhães et al., 2011). Table 3 shows that the pH value of kefir without or with the addition of butterfly pea flower powder up to 1.5% did not produce a difference in pH value, as well as 12 days of storage yielded the same relative pH value ($P>0.05$). These results are different from previous research (Setyawardani and Sumarmono, 2015) on cold temperature storage, which resulted in differences in the pH value of kefir, with a kefir pH value of 4.37-5.17.

The process of decreasing pH begins as lactose diminishes from 4.92 to 4.02%, the value of L (+)-lactic acid increases from 0.01 to 0.76% and the pH drops to 4.2 during 24 hrs of fermentation. After 24 hrs, lactose degrades more slowly, pH decreases, and L(+) levels decrease while D (-) increases (Fontán et al., 2006). Temperature is a factor in the fermentation process which greatly affects the growth of bacteria (Lacroix and Yildirim, 2007). The initial pH value of fresh goat's milk is 6.7 and drops to 4.5 after 24 hrs.

4. Conclusion

Kefir made from goat's milk with the addition of butterfly pea flower up to 1.5% has the highest average antioxidant activity, LAB and yeast, but lower protein and fat, while the water content, pH and water activity of the product are relatively the same.

Conflict of interest

The authors declare no conflict of interest.

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