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The Influence of the Introduction of Fibre-rich Bran on the Quality of Kefir

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ABSTRACT

Influences of kefir samples added with sesame cake (SB) (2% and 4%) and rice bran (RB) (0.1% and 0.3%) on physicochemical, microbiological and sensory qualities were studied every seven days in 28 days. The most preferred kefir through the sensorial evaluation was kefir added with RB (0.3%), followed by RB (0.1%), SB (2%) and SB (4%). The responses of pH, acidity, colour, WHC, viscosity, probiotics counts test showed striking differences (p< 0.05) in the formulations. The best formulations demonstrate good sensory acceptance and purchase intention.

Keywords: Kefir, sesame cake, rice bran, stability, probiotics, sensory

Mathematics Subject Classification : 92C70

Journal of Economic Literature (JEL) Classification Number: L66

1. INTRODUCTION

Kefir is a kind of popular fermented milk drink, and it is produced by the injection of kefir grain into cow milk traditionally. It originated from Caucasian mountains. Numerous lactic acid bacteria, yeasts and acetic acid bacteria are involved in the polysaccharide structure of kefir grain (Erdogan et al., 2018). kefir is popular not only for its unique taste, many studies showed its heath effect. A study showed that kefir and its ingredients are beneficial to health, have a positive influence on the immune and gastrointestinal systems (Iraporda et al., 2014). Some studies suggest it helped to confront lactose intolerance (Mo et al., 2015), play a role in cholesterol metabolism (Dong-Hyeon et al., 2017), revealed antagonism effect against colon carcinogens (Ahmed et al., 2013). It was the source of some vitamins (Wyk et al., 2011). In addition, kefir cultures could protect food safety by inhibiting E. coli and pathogens (Wyk et al., 2011).

Kefir could combine with many kinds of plant ingredients. Many scientists devoted themselves to healthy food by introducing plant ingredients into kefir (Zaharova, 2014). Studies showed that the introduction of plant ingredients would lead to the decrease of viscosity, the separation of whey, and the decrease of sensory. Those negatives caused the addition of flavours and stabilizers, these additives would lead to the reduction of the population of probiotics, so as to lower the biological value of kefir (Huang et al., 2015; Liu et al., 2018; Shleikin, 2015). Therefore, the pressing task is to introduce kinds of plant ingredients, which would have no negative influence on kefir, especially on the stability of kefir.

Recently, the marked tendency is the introduction of dietary fibre into kefir. Dietary fibre is good for health, and it has the effect of colon cancer prevention, constipation prevention, diabetes prevention and weight loss (a et al., 2017; Carvalho et al., 2019; Fernández et al., 2019; Li et al., 2019). Some studies showed the influences of dietary fibre on kefir, including effect on probiotics, rheological properties (Aguiar et al., 2013; Goncu, 2017). Some studies showed that the introduction of dietary fibre could lower the sour of kefir, so as to strengthen the acceptability of kefir (Hekmat & Irvine, 2011). The introduction of fibre could stimulate multiplying of probiotics (Desai et al., 2004).

DSC is a kind of by-product which has always been discarded or fed to animals. The extract of oil from sesame lead to the production of DSC, which contains crude fibre (10.8 g/100 g), high calcium (1.5 g/100 g), and 50% protein(A. A. A. Mohdaly et al., 2013); DSC also contains phenolic compounds which showed the activities of antimicrobial, antimutagenic and antioxidant (Reham et al., 2019; Yashaswini et al., 2017). There are also functional components called lignans (Yang et al., 2019) and several minerals, like calcium, around 9.6–12.8 g/kg, phosphorus, around 1.7–2.3 g/kg, potassium , around 4.6–5.3 g/kg and magnesium, around 0.018–0.052 g/kg)(Alyemeni et al., 2011; Zouari et al., 2016).

RB is the by-product of flour processing and constitutes about 10% of the total weight of the whole rice (Hu et al., 1996). It is mainly composed of aleurone, sub aleurone layer, germ and pericarp. 90% of RB in the world was used to feed animals, and the rest was to extract rice bran oil (Zullaikah et al., 2009). RB is rich in antioxidants, such as vitamin E, carotenoids, polyphenols and tocotrienols, which help to prevent oxidative damage to DNA and other body tissues (Jariwalla, 2001). It is a good quality resource of protein, minerals, oil and dietary fibre (Moongngarm et al., 2012). Rice bran contains minerals such as magnesium, iron and phosphorus, 12.07–13.66% crude protein, 11.77–12.68% of fibres and 15.85–18.80% oil (Moongngarm et al., 2012). The protein in RB is of good biological value, and it has appropriate amino acid composition and high biological potency, the lysine content reaches as high as 5.8g/100g. Oil in RB is beneficial to lower blood pressure and improve lipid characteristics of patients with mild to moderate hypertension (Devarajan et al., 2016; Perez-Ternero et al., 2017), prevent colon cancer (Li et al., 2011). Fibre in RB can help to keep the health of the gut. In recent days, the applications of RB as food additives were focused on: the extraction of protein (Phongthai et al., 2016), fibre (Jia et al., 2019), oil (Soares et al., 2016; Trevisani Juchen et al., 2019), vitamin B

(Chen et al., 2011) and other biological components (Tabaraki & Nateghi, 2011); the stabilization of rice bran (Patil et al., 2016); the supplement of RB into bread (Tuncel et al., 2014), sausage (Choi et al., 2010), drinks (Prestes et al., 2019). Few kinds of research were about the supplement of RB in fermented milk.

Considering economic benefit and ecological efficiency, the utilizing of dietary fibre in food is attractive (Karintseva O.I., 2017; Lyshenko, M. O.; Makarenko, N. O.; Mushtai, V. A., 2021). Additionally, introducing fibre into food would produce healthy food (Adel Abdelrazek A. Mohdaly et al., 2013). It would be a significant attempt to introduce DSC and RB into kefir. Qin's study showed that the introduction of 0.1% RB into kefir would significantly improve the viscosity of kefir, increase the population of probiotics; 2% DSC had a similar effect, but there is no comparative study of RB and DSC (Qin et al., 2021). Take RB and DSC as resources, this study conducted a comparative study. In this study, pH, acid, water-holding capacity (WHC), viscosity, the population of probiotics, of different kefir samples were studied. The aim of the study was to seek role characteristics of different resources of fibre, and lay the theoretical and practical foundation for the usage of dietary fibre in kefir.

2. MATERIAL AND METHODS

2.1. Materials

Kefir grains (local farmer in Tibet, China); Cow milk (Mengniu Dairy Group Co, Neimenggu, China); DSC (local market in Hezhou, China); RB (local market in Xingtai, Hebei, China); Chemicals (analytical grade).

2.2. Kefir production

Cow milk was inoculated with kefir at a ratio of 10% (V/V). Five formulations were studied: control samples (S_0), kefir added with 0.1% amount of RB (S_1), kefir added with 0.3% amount of RB (S_2), kefir added with 2% amount of DSC (S_3), and kefir added with 4% amount of DSC (S_4). All kinds of the mixture were fermented at 28℃for about 22h until pH reached 4.7, and then stored at 4℃ for 28 days.

2.3. Physicochemical properties

Physicochemical indexes, including pH, total titratable acidity, apparent viscosity, water-holding capacity, colour measurements and nuclear magnetic resonance, they were studied every seven days in 28 days.

pH meter (METTLER TOLEDO LE438, Switzerland) was used to measure pH value; The titratable acidity was determined as (Guler-Akin and Akin 2007). A digital viscometer (NDJ-8S, Shanghai, China) was used to determine the apparent viscosity.

WHC of kefir was measured as (Mudgil et al., 2016). The WHC was obtained according to the following formula:

$$WHC\ (\%) = [(X-Y)/X] \times 100$$

Colour measurement and nuclear magnetic resonance experiment were conducted as (Qin et al., 2021)

2.4. Microbiological analysis

The population of Lactobacillus and Lactobacillus were conducted as (Kabakc et al., 2020), The population of yeast was conducted as (Kabakc et al., 2020).

2.5. Sensory analysis

The sensory analysis was conducted as (Kabakc et al., 2020).The scoring criteria were shown in table 1.

Table 1: Scoring criteria for kefir

Items	standard for evaluation	score
colour	Uniform colour and slight yellow	8-9
	slight delamination, slight yellow	7-8
	delamination, uneven colour	<7
consistency	Moderate consistency and heavy palate	8-9
	slightly thin consistency	7-8
	thin or heavy consistency	5-7
	very thin or heavy consistency	<5
sour	Mild sour taste, without astringency	8-9
	slight or heavy sour taste, without astringency	7-8
	slight sour taste and astringency	6-7
	very slight or heavy sour taste, and heavy astringency	<6
texture	uniform and smooth texture, exquisite structure, without bubbles	8-9
	slightly uniform and smooth texture, slightly exquisite structure, without bubbles	7-8
	slightly rough texture, a small number of bubbles	5-7
	rough texture, more bubbles	<5
flavor	intense flavor of rice and kefir	8-9
	moderate flavor of rice and kefir	7-8
	moderate flavor of kefir and slight flavor of rice	5-7
	moderate flavor of kefir and without flavor of rice	<5

Remarks:

In all the tables:

* a, b, c, d, e Represent different superscripts noteworthy differ in the same column (P<0.05)

* $^{A, B, C, D, E}$ Represent different superscripts noteworthy differ in the same row (P<0.05)

* SD: Standard deviation

In all the figures:

* $^{a, b, c, d, e}$ Represent different superscripts noteworthy differ in the same column (P<0.05)

* $^{A, B, C, D, E}$ Represent different superscripts noteworthy differ in the same row (P<0.05)

* SD: Standard deviation

2.6. Statistical analysis

All experiments were repeated three times, and the result were shown as the mean± standard error of three independent experiments. Tukey's multiple range test was used to calculate the noteworthy differences at the P = 0.05 level among mean values. The Data Processing System software (DPS version 7.05, SAS Institute, Inc., 2000) was used to conduct statistical analyses.

3. RESULTS

3.1. Physicochemical properties

3.1.1. pH and Acidity

The results of pH and titratable acidity were shown in table 2 and figure 1. pH value of kefir samples changed within 3.95-5.06, titratable acidity value changed within 64.21-205.57. The introduction of supplements could strikingly decrease the pH value and increase the titratable acidity value ($p< 0.05$). The more supplement added, the smaller the pH value was, the higher the titratable acidity value was. This maybe caused by the protein and dietary fibre in RB and DSC, which have the function of water holding.

The storage period significantly influenced pH value and titratable acidity value ($p< 0.05$) of kefir. The longer the storage time, the lower the pH value was, and the higher the titratable acidity value was. This was caused by the post fermentation in kefir during storage period.

Table 2: pH value and titratable acidity of kefir samples in 28 days

	Samples	Day 0	Day 7	Day 14	Day 21	Day 28
pH	S_0	5.06±0.02$^{a, A}$	4.94±0.01$^{a, B}$	4.79±0.00$^{a, C}$	4.61±0.01$^{a, D}$	4.54±0.01$^{a, E}$
	S_1	4.92±0.00$^{b, A}$	4.74±0.04$^{b, B}$	4.65±0.01$^{b, C}$	4.49±0.02$^{b, D}$	4.43±0.02$^{b, E}$
	S_2	4.74±0.01$^{c, A}$	4.63±0.01$^{c, B}$	4.52±0.01$^{c, C}$	4.38±0.01$^{c, D}$	4.34±0.00$^{c, E}$
	S_3	4.38±0.03$^{d, A}$	4.16±0.02$^{d, B}$	4.14±0.02$^{d, B}$	4.06±0.00$^{d, C}$	4.07±0.02$^{d, C}$
	S_4	4.25±0.04$^{e, A}$	4.05±0.04$^{e, B}$	4.03±0.00$^{e, BC}$	3.97±0.00$^{e, CD}$	3.95±0.00$^{e, D}$
Titratable acidity, (oT)	S_0	64.21±0.42$^{e, D}$	67.14±1.08$^{d, CD}$	72.00±1.97$^{e, AB}$	68.93±0.68$^{e, BC}$	75.14±0.51$^{d, A}$
	S_1	70.02±0.89$^{d, B}$	74.01±3.16$^{d, B}$	82.05±0.26$^{d, A}$	80.30±0.72$^{d, A}$	82.69±1.32$^{cd, A}$
	S_2	77.58±1.05$^{c, D}$	86.15±0.41$^{c, C}$	91.42±0.36$^{c, AB}$	89.01±2.27$^{c, BC}$	94.33±0.61$^{c, A}$
	S_3	112.07±0.92$^{b, C}$	125.88±4.75$^{b, B}$	133.46±1.62$^{b, B}$	157.43±4.03$^{b, A}$	163.52±6.04$^{b, A}$
	S_4	117.34±2.18$^{a, E}$	155.27±1.38$^{a, D}$	167.25±2.77$^{a, C}$	191.12±3.53$^{a, B}$	205.57±8.26$^{a, A}$

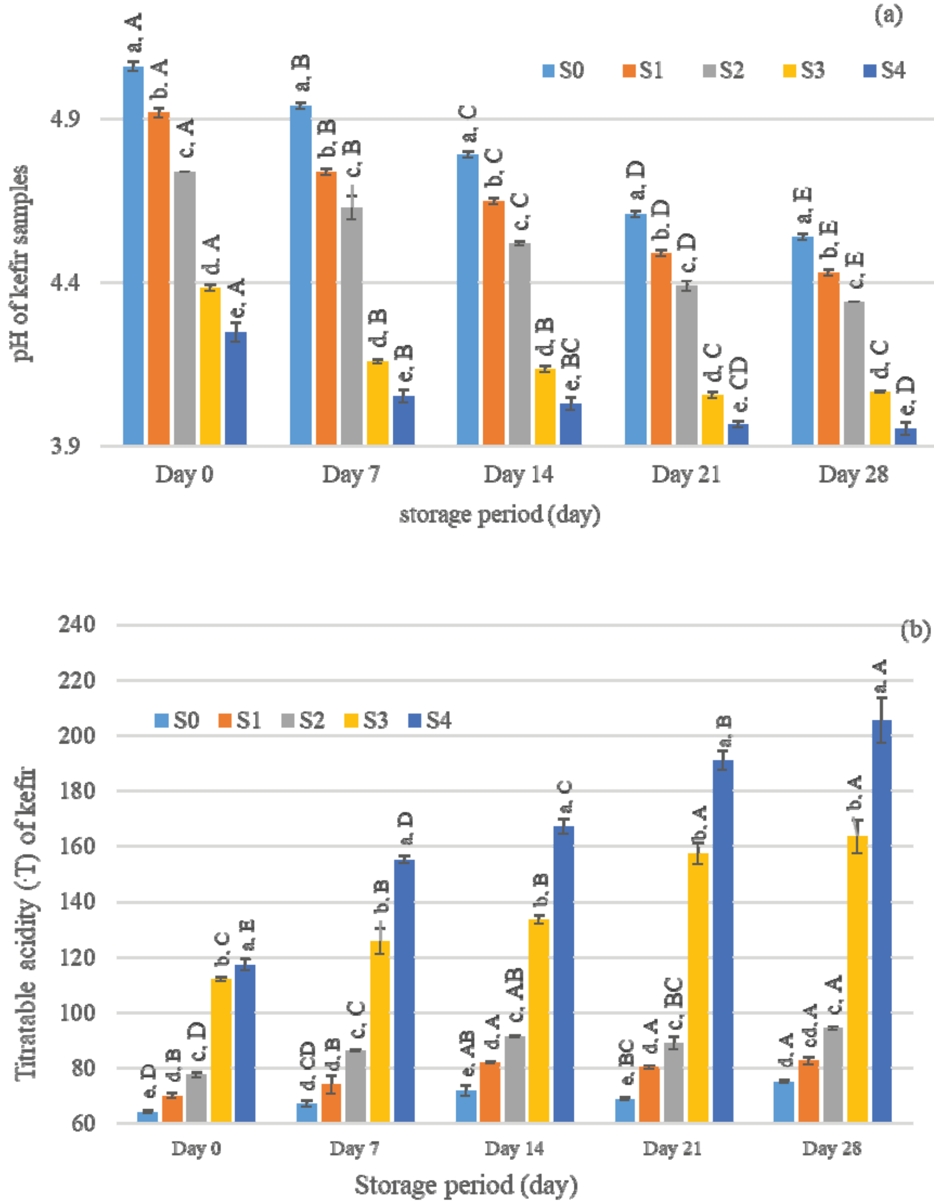

Fig. 1. The pH value (a) and titratable acidity value (b) of kefir

3.1.2. WHC

Table 3: WHC of kefir in 28 days (n=3, ±SD)

	Samples	Day 0	Day 7	Day 14	Day 21	Day 28
WHC (%)	S_0	$50.17\pm2.34^{c, A}$	$44.84\pm0.69^{d, B}$	$49.30\pm0.30^{c, A}$	$48.33\pm0.44^{c, AB}$	$47.47\pm0.29^{d, AB}$
	S_1	$50.67\pm1.94^{c, A}$	$49.82\pm0.71^{c, A}$	$49.49\pm0.32^{c, A}$	$49.33\pm0.17^{c, A}$	$50.55\pm0.42^{cd, A}$
	S_2	$55.58\pm0.65^{b, A}$	$48.71\pm0.67^{c, B}$	$49.84\pm0.17^{c, B}$	$48.81\pm0.51^{c, B}$	$49.40\pm0.01^{cd, B}$
	S_3	$67.76\pm0.85^{a, A}$	$64.4\pm1.28^{b, B}$	$62.07\pm0.45^{b, C}$	$62.56\pm1.198^{b, BC}$	$61.21\pm1.36^{b, C}$
	S_4	$67.49\pm2.26^{a, AB}$	$68.44\pm0.41^{a, A}$	$66.73\pm1.23^{a, AB}$	$64.49\pm0.28^{a, B}$	$64.30\pm0.79^{a, B}$

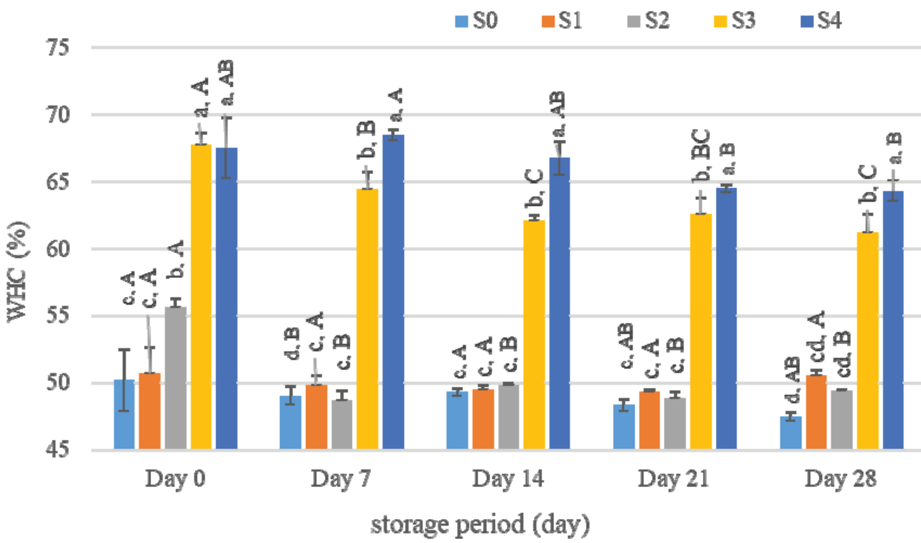

Fig. 2. WHC (%) of kefir samples

3.1.3. Apparent viscosity

The results of apparent viscosity were shown in table 4 and figure 3. RB made no significant difference on the apparent viscosity of kefir ($P> 0.05$), because of the tiny amount; DSC made significant difference on the apparent viscosity of kefir ($P<0.05$), because of the high adding amount of DSC. The more the supplement was added, the higher the apparent viscosity was, this was caused by the high content of protein and dietary fibre in RB and DSC.

Totally speaking, the apparent viscosity showed a tendency of first rise then decreased as the storage period prolonged. The apparent viscosity raised significantly ($P<0.05$) on the 7th day for all samples except for samples added with 4% of DSC.

Table 4: Apparent viscosity of kefir samples in 28 days (n=3, ±SD)

	Samples	Day 0	Day 7	Day 14	Day 21	Day 28
Apparent viscosity（mPa*s）	S_0	64.17±3.86 $^{c, C}$	702.83±3.01 $^{c, B}$	1023.33±17.74 $^{d, A}$	1095.83±80.01 $^{b, A}$	1003.33±147.95 $^{b, A}$
	S_1	131.20±1.06 $^{c, C}$	1284.33±73.05 $^{c, A}$	1211.83±32.04 $^{d, A}$	1322.5±49.94 $^{b, A}$	988.75±5.30 $^{b, B}$
	S_2	243.33±20.23 $^{c, D}$	1605.00±10.00 $^{c, B}$	2645±45.83 $^{c, A}$	1536.67±46.46 $^{b, B}$	1210.83±45.85 $^{b, C}$
	S_3	4866.67±372.87 $^{b, B}$	6680.00±767.07 $^{a, A}$	3256.67±341.96 $^{b, C}$	3880±113.58 $^{a, BC}$	5060±642.81 $^{a, B}$
	S_4	7533.33±921.16 $^{a, A}$	3720.00±190.79 $^{b, C}$	6520.00±87.18 $^{a, AB}$	3523.33±941.08 $^{a, C}$	5716.67±669.80 $^{a, B}$

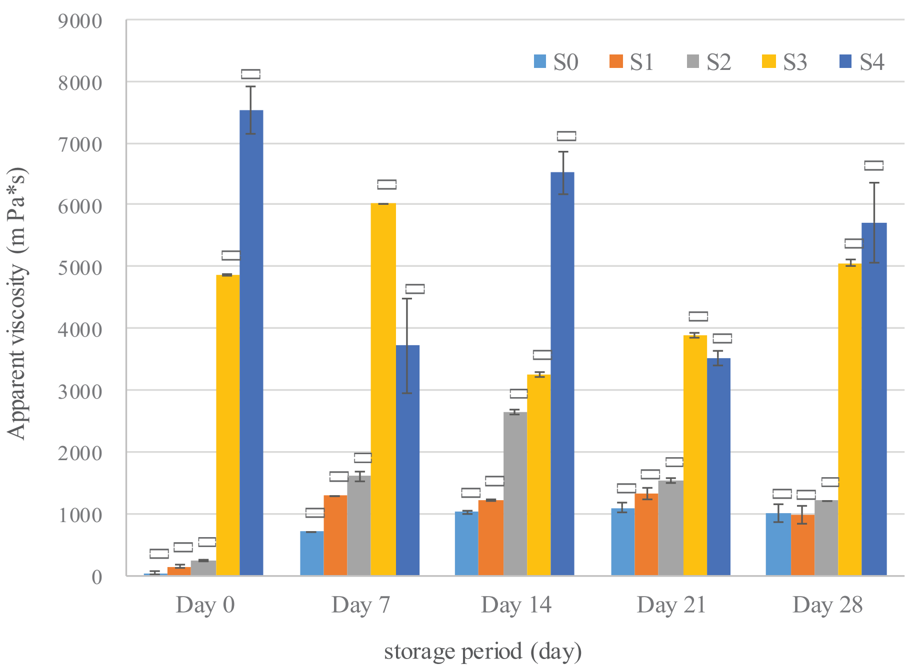

Fig.3. Apparent viscosity of kefir in 28 days (n=3, ±SD)

3.1.4. Colour

Table 5: Colour of kefir in 28 days (n=3, ±SD)

Samples	Storage period (day)	L	a	b
S_0	0	97.91±0.18 $^{a, A}$	2.57±0.03 $^{cd, D}$	3.77±0.04 $^{c, A}$
	7	97.59±0.20 $^{a, AB}$	3.12±0.02 $^{bc, A}$	3.45±0.10 $^{c, BC}$
	14	95.31±0.20 $^{b, C}$	2.74±0.10 $^{b, C}$	3.39±0.08 $^{c, C}$
	21	97.47±0.21 $^{a, AB}$	2.77±0.06 $^{c, BC}$	3.61±0.03 $^{b, AB}$
	28	97.32±0.18 $^{a, B}$	2.92±0.06 $^{d, B}$	3.59±0.05 $^{c, B}$
S_1	0	97.07±0.05 $^{b, B}$	2.42±0.03 $^{d, D}$	3.28±0.05 $^{e, AB}$
	7	97.25±0.05 $^{ab, A}$	2.99±0.03 $^{c, A}$	3.08±0.05 $^{d, B}$
	14	95.42±0.02 $^{b, D}$	2.86±0.04 $^{b, B}$	3.11±0.05 $^{c, B}$
	21	97.20±0.05 $^{a, AB}$	2.73±0.03 $^{c, C}$	3.40±0.11 $^{cd, A}$
	28	96.90±0.09 $^{b, C}$	2.96±0.08 $^{d, AB}$	3.28±0.15 $^{d, AB}$
S_2	0	96.56±0.17 $^{b, A}$	2.59±0.11 $^{c, C}$	3.53±0.06 $^{d, B}$
	7	96.45±0.02 $^{bc, AB}$	2.78±0.04 $^{d, BC}$	3.09±0.06 $^{d, C}$
	14	94.87±0.07 $^{c, D}$	2.96±0.2 $^{b, B}$	3.27±0.19 $^{c, C}$
	21	96.19±0.08 $^{b, C}$	2.78±0.03 $^{c, BC}$	3.34±0.06 $^{d, BC}$
	28	94.31±0.03 $^{c, BC}$	3.82±0.10 $^{a, A}$	4.06±0.03 $^{b, A}$
S_3	0	95.6±0.40 $^{c, B}$	3.04±0.04 $^{b, B}$	4.03±0.09 $^{b, A}$
	7	96.06±0.30 $^{c, AB}$	3.21±0.06 $^{b, AB}$	3.92±0.03 $^{b, A}$
	14	96.35±0.03 $^{a, A}$	3.34±0.08 $^{a, A}$	3.91±0.10 $^{b, A}$
	21	96.45±0.08 $^{b, A}$	3.05±0.05 $^{b, B}$	3.55±0.08 $^{bc, B}$
	28	96.41±0.11 $^{c, A}$	3.27±0.09 $^{c, A}$	3.62±0.11 $^{c, B}$
S_4	0	94.35±0.32 $^{d, A}$	3.43±0.06 $^{a, C}$	5.53±0.11 $^{a, A}$
	7	94.94±0.57 $^{d, A}$	3.61±0.08 $^{a, A}$	5.25±0.03 $^{a, B}$
	14	94.59±0.11 $^{c, A}$	3.6±0.04 $^{a, AB}$	5.21±0.12 $^{a, B}$
	21	95.15±0.09 $^{c, A}$	3.46±0.02 $^{a, BC}$	5.12±0.09 $^{a, BC}$
	28	94.90±0.06 $^{d, A}$	3.49±0.04 $^{b, ABC}$	4.89±0.04 $^{a, C}$

The results of “L”, “a” and “b” were shown in table 5. The “L” value changed within 94.31- 97.91, the “a” value changed within 2.42- 3.82, and the “b” value changed within 3.08- 5.53.
The introduction of supplements could significantly influence the “L”, “a” and “b” values of samples ($P<0.05$). More supplements lead to lower “L” value and higher “a”, “b” value, which showed that the introduction of supplement could observably darken the lightness and deepen the red and yellow colour of samples.

The storage period could observably influence the “L”, “a” and “b” values of samples ($P<0.05$). For control samples and samples added with RB, the storage period could significantly darken the lightness of samples ($P<0.05$); For samples added with DSC, the storage period made no significant difference on the lightness ($P>0.05$). With the prolonging of the storage period, the “a” value showed a tendency of rising first then went down, the highest value of “a” was on the 7th day, showed that the red colour of samples raised first then went down. For control samples and samples added with RB, the minimum value of “b” was on the 14th day, which means samples own the lightest yellow colour on the 14th day. For samples added with DSC, the yellow colour deeper as storage time prolonged.
3.1.5. Nuclear magnetic resonance experiments

T_{23} was taken as the main object of study as (Qin et al., 2021).

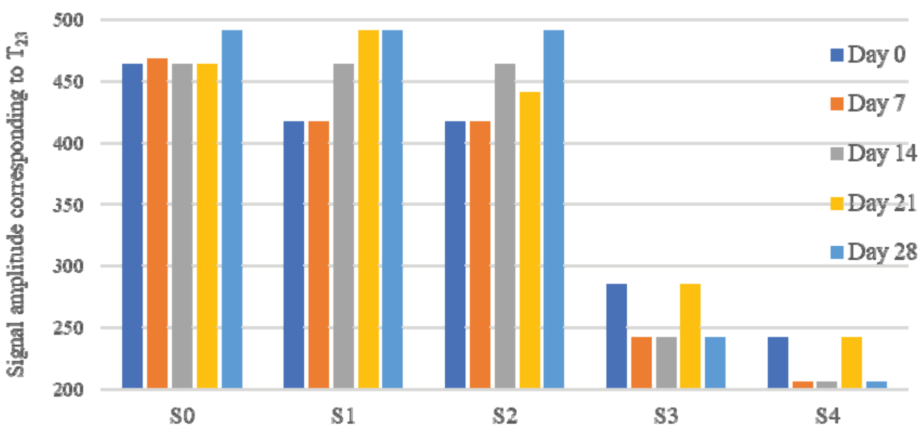

Fig.4. Signal amplitude corresponding to T_{23}

The results of NMR of samples were shown in fig. 4. Results showed that 2% DSC and 4% DSC could noteworthy reduce the signal amplitude corresponding to T_{23}, showed that kefir added with 2% and 4% DSC could noteworthy reduce the free water content, samples presented as a stable gelatinous. The introduction of RB made no noteworthy difference on the signal amplitude corresponding to T_{23}, signified that samples added with RB made no effect on the stability of kefir, which was due to the tiny amount of RB.

For control samples, the storage period made no noteworthy difference on the signal amplitude corresponding to T_{23} except for day 28; For sample added with RB, the storage period could noteworthy increase the signal amplitude corresponding to T_{23}, signify the reduction in stability. For samples added with DSC, storage period could noteworthy decrease the signal amplitude corresponding to T_{23} on the 7^{th} day, signifying the improvement in stability, the signal amplitude corresponding to T_{23} kept steady in the following days, signifying that the stability remained constant.

3.2. Microbiological analysis

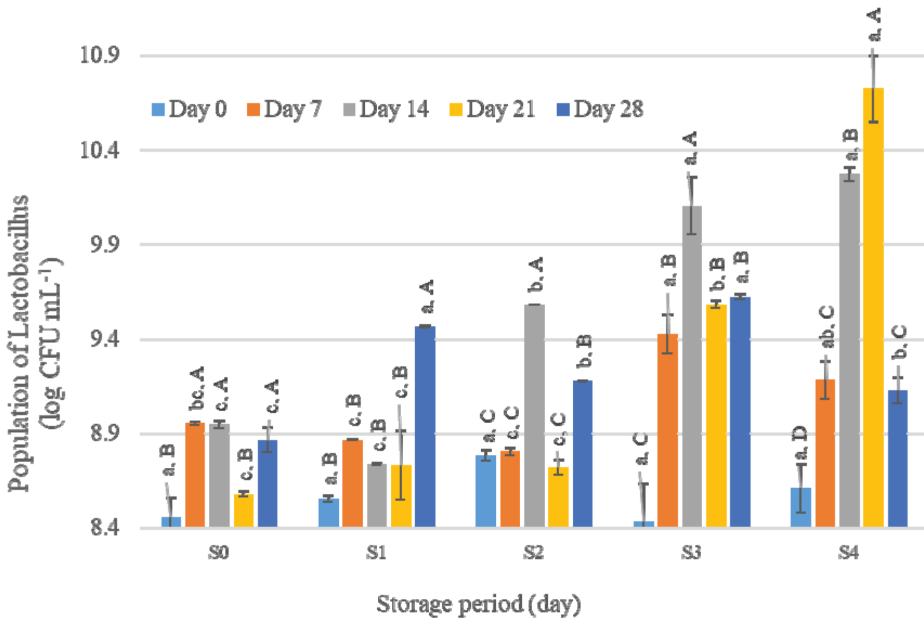

Fig.5. Population of Lactobacillus of kefir in 28 days (n=3, ±SD)

The results of the population of Lactobacillus were shown in figure 5. Results showed that the supplements could significantly stimulate the reproduction of Lactobacillus ($P< 0.05$) when the adding amount was higher than 0.3%.

The storage period could significantly influence the population of Lactobacillus ($P< 0.05$). The population of Lactobacillus reached the maximum on the 14^{th} day.

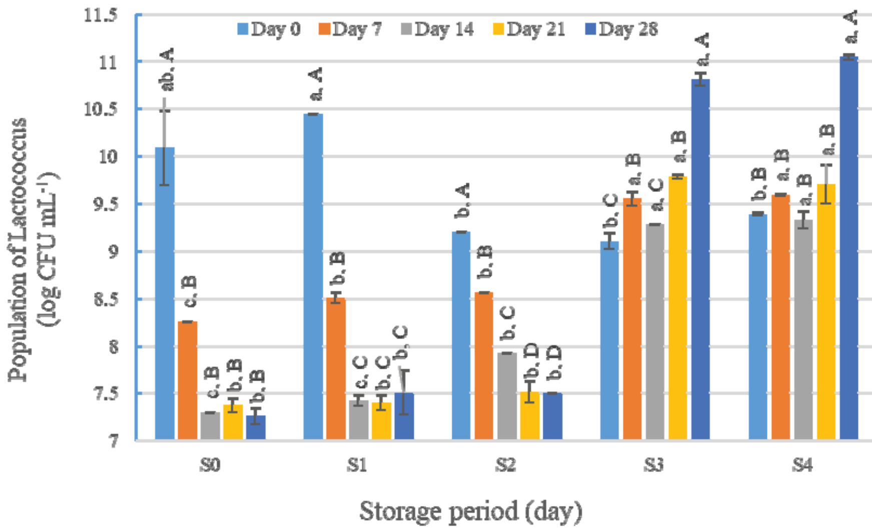

Fig.6. Population of Lactococcus of kefir in 28 days (n=3, ±SD)

The results of the population of Lactococcus of kefir samples were shown in figure 6. The introduction of supplements could significantly stimulate the reproduction of Lactococcus ($P< 0.05$), especially when the amount was more than 0.3%, this may be caused by the stimulation of dietary fibre in RB and DSC.

The storage period made a significant difference on the population of Lactococcus. For the control sample and sample added with RB, the population of Lactococcus decreased as storage time prolonged; For samples added with DSC, the population of Lactococcus increased as storage time extending, this could be explained as dietary fibre could stimulate multiplication during storage.

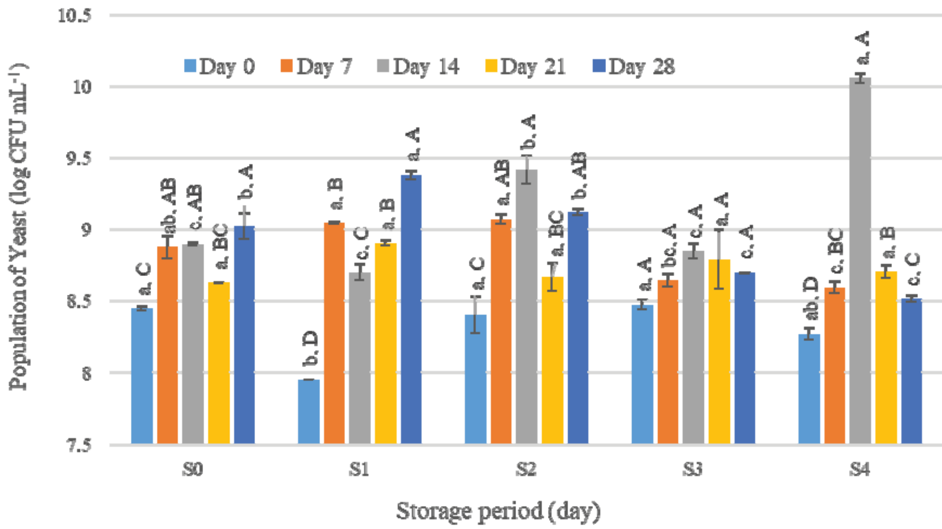

Fig.7. Population of Yeast of kefir in 28 days (n=3, ±SD)

The results of population of Yeast were shown in figure 7. The introduction of supplements could significantly stimulate the multiplication of yeast (P<0.05). The storage period could substantially influence the population of Yeast (P<0.05), the population of Lactobacillus reached maximum on the 14^{th} day.

4. DISCUSSION AND CONCLUSION

It was the first time of the introduction of RB into kefir, Result showed that the introduction of RB would give many benefits to kefir, it can improve the health benefits to kefir because of the increase of fibre and probiotics. Data on the population of probiotics suggest that nutrients brought by RB promoted the growth of probiotics. The storage period affected significantly on the population of Lactobacillus, yeast and Lactococcus (P<0.05). The introduction of RB could improve the population of lactobacillus significantly when it reached 0.3%. The population of Lactobacillus was maximum on the 14th day. The introduction of RB made no difference on the population of yeast. The population of Lactococcus declined significantly within 14 days (P<0.05), and kept steady in the following days.; It would improve the sensory profile of kefir because of the increase of viscosity. The introduction of RB could increase the WHC of kefir significantly (P<0.05); The storage period made no striking difference on WHC (P>0.05) except for the first week. The adding of RB could increase the apparent viscosity significantly (p<0.05), more RB led to higher apparent viscosity. The storage period influenced the apparent viscosity significantly (p<0.05), the apparent viscosity increased at the beginning and decreased then with the prolonging of storage period, samples had the highest apparent viscosity on the 14th day. In terms of sensory, the introduction of RB would increase the thickness and rich the flavor of kefir, but also lead to whey layered and rough structure; The more RB was added, the greater the negative impact was, the appropriate ratio of RB was 0.1%. It would improve economic benefit because of the cyclic utilization of RB. Also the introduction of RB into kefir could increase the pH and decrease the acidity significantly (P<0.05), which may partially be attributed to the protein and fibre in RB. The storage period could increase the pH and decrease the acidity significantly (P<0.05). The adding amount of RB made a difference on the colour of kefir. The introduction of RB could decrease the lightness of kefir, increase the degree of red colour and blue colour of samples. The introduction of RB could reduce the signal amplitude of samples, means that RB could decrease the content of free water, make samples thicker. The prolonging of storage period could improve the signal amplitude significantly, showing that it can increase the content of free water, so as to make samples thinner.

According to the studies on physicochemical, rheological, microbiological and sensory properties, RB can be considered as one of the potential supplements of kefir.

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