# BIOLOGICAL SCIENCES

UDC 579

## THE INFLUENCE OF DIETARY FIBER IN RICE BAN ON KEFIR

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**Abstract:** Rice bran is a kind of by-products of agricultural processing, they are rich in dietary fiber and other nutrients. In modern society, dietary fibre is increasingly being paid attention for its health benefits. Kefir is a functional beverage and little known to consumers. This study aimed to study the influence of dietary fiber in rice bran on the physical properties of kefir, including water holding capacity and viscosity.

Kefir supplemented with 0, 0.1%, 0.3%, 0.5%, 0.7% amount of rice bran were studied. Samples were stored for 28 days at 4±1°C. Results showed that the introduction of rice bran could significantly improve the water holding capacity and viscosity of kefir because of the fiber in rice bran. To get a better quality of kefir, rice bran should be pretreated: crushing, decolorization, deodorization and other pretreatment. And more adding amount of introduction lead to bad taste, so the urgent problem needs to resolve is decrease the adverse effect of rice bran on kefir.

**Key words:** Rice bran, Kefir, Water holding capacity, viscosity, Influence

## 1 Introduction

RB is a by-product of rice milling industry and constitutes around 10% of the total weight of rough rice [1, p. 653]. It is primarily composed of aleurone, pericarp, sub aleurone layer and germ. Each year 90% of the RB produced in the world is utilized cheaply as a feed stock for cattle and poultry, and the remainder is used for extraction of RB oil [2, p. 299]. Protein in RB is a kind of high-quality protein, it has appropriate amino acid composition and high biological potency, the lysine content reaches as high as 5.8g/100g. Oil in RB can help to lower blood pressure and improve the lipid profile in mild-to-moderate hypertensive patients [3, p. 399] [4, p. 58], prevent colon cancer [5, p. 209]. Fiber in RB can help to keep the health of gut.

Kefir is well quenched thirst and stimulate appetite, can become the basis of daily nutrition. It is necessary to expand its range through the introduction of dietary fiber, with the aim of balancing in all the most probably important nutrients. Thus, innovative facets regarding the usage of these plants as co-products for further production of food additives or supplements or value-added products with high nutritional value are gaining increasing interest. Further their recovery and utilization are economically and ecologically attractive [6, p. 397].

## 2 Research methodology

Kefir grains were obtained from private households in Tibet, China. Cow milk was supplied from Mengniu Dairy Group Co, Neimenggu, China. All chemicals were of analytical grade. Other media (agar) and reagents used for microbiological analyses were obtained from Merck (Darmstad, Germany). In all analyses, the ultrapure water (18.2 MΩ.cm) was used (Millipore Simplicity UV, Molsheim, France).

Kefir was used as start culture at a ratio of 10% (V/V). Five raw materials formula were investigated: cow milk added with 0 (control), 0.1% (A), 0.3% (B), 0.5% (C), 0.7% (D) amount of RB. All kinds of mixture were fermented at 28℃for 22h until pH reached to 4.7, kefir samples were stored at 4 °C for 28 days.

The water-holding capacity and apparent viscosity of kefir were studied for all samples. All the indexes were studied every 7 days for 28 days.

The apparent viscosity of the samples was measured with a digital viscometer (NDJ-8S, Shanghai, China).

WHC of kefir was determined using a centrifuge.

10g of kefir (X) samples were weighed into 50mL test tube and centrifuged at 3000 rpm for 20 min at 4°C. The separated whey (Y) was removed and weighed. The water-holding capacity was calculated as

WHC (%) = [(X-Y)/X] x100)

## 3 Results

### 3.1 WHC

WHC, one of the desirable features for kefir quality, is related to the water keeping ability of proteins within the kefir. Results of WHC were showed in table 1 and figure 1. WHC ranged from 44.84% to 56.36% during storage. Results showed that 0.3% of RB could significantly ($P < 0.05$) improve the WHC of kefir, but there was no significant difference ($P > 0.05$) of WHC when more RB was added. WHC of plain kefir was lower than kefir added with RB, regardless of the addition level of RB. As the RB addition ratio increased, WHC of the samples increased, but there were not statistically differences ($p > 0.05$) among kefir added with different RB levels. This may be explained that RB contains dietary fibers such as b-glucan, pectin, galactooligosaccharide (GOS), hemicellulose, arabinogalactan, which could improve the water holding capacity of kefir. Furthermore, [7, p. 90] showed that hemicellulose and insoluble dietary fibers from RB had many desirable properties including high water-holding capacity and swelling capacity, these specialties provided kefir with firmer texture. [8, p. 83] also observed that barley and oat b-glucan dramatically decreased whey separation in yoghurts containing B. bifidum.

Storage period made no significant effect ($P > 0.05$) on WHC of kefirs except for the first week. The WHC declined significantly for the first week for all samples ($P<0.05$).

**Table 1**

**WHC of kefir samples during storage for 28 days (n=3, ±SD)**

| | Samples | Day 0 | Day 7 | Day 14 | Day 21 | Day 28 |
|---|---|---|---|---|---|---|
| WHC (%) | 0 | $50.17\pm2.34^{b, A}$ | $44.84\pm0.69^{b, B}$ | $49.30\pm0.30^{b, A}$ | $48.33\pm0.44^{b, AB}$ | $47.47\pm0.29^{c, AB}$ |
| | 0.1% | $50.67\pm1.94^{b, A}$ | $49.82\pm0.71^{a, A}$ | $49.49\pm0.32^{b, A}$ | $49.33\pm0.17^{ab, A}$ | $50.55\pm0.42^{ab,}$ A |
| | 0.3% | $55.58\pm0.65^{a, A}$ | $48.71\pm0.67^{a, B}$ | $49.84\pm0.17^{b, B}$ | $48.81\pm0.51^{ab, B}$ | $49.40\pm0.01^{b, B}$ |
| | 0.5% | $56.36\pm0.37^{a, A}$ | $48.98\pm0.62^{a, B}$ | $51.29\pm0.17^{a, B}$ | $51.09\pm1.62^{a, B}$ | $51.09\pm0.42^{a, B}$ |
| | 0.7% | $55.91\pm0.38^{a, A}$ | $50.04\pm0.63^{a, B}$ | $50.89\pm0.64^{a, B}$ | $50.86\pm0.42^{a, B}$ | $50.64\pm0.06^{a, B}$ |

* a, b, c, d, e Means in the same column with different superscripts significantly differ ($P<0.05$)

* A, B, C, D, E Means in the same row with different superscripts among kefir samples significantly differ ($P<0.05$)

* SD: Standard deviation

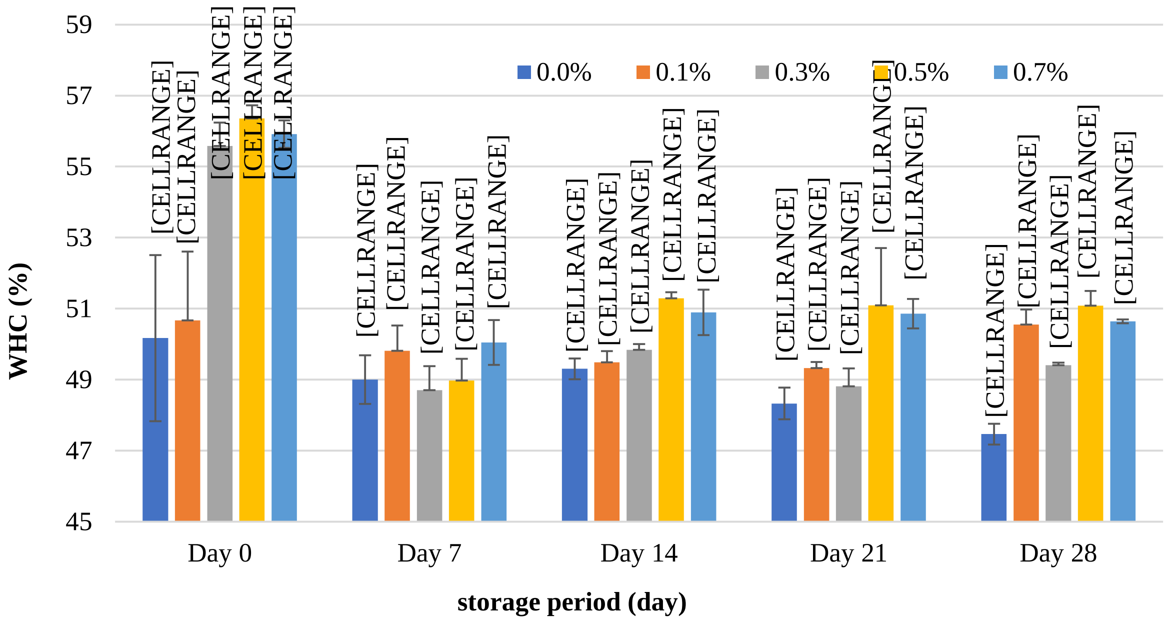


**Fig. 1. WHC of kefir samples in 28 days**

* a, b, c, d, e Means in the same column with different superscripts significantly differ ($P<0.05$)

* A, B, C, D, E Means in the same row with different superscripts among kefir samples significantly differ ($P<0.05$)

* SD: Standard deviation

3.2 Apparent viscosity

Figure 2 and table 2 presented the apparent viscosity values of kefir in 28 days. Compared with control sample, RB can significantly improve the apparent viscosity of kefir, because the textures of these products were affected by weak physical bonds, electrostatic and hydrophobic interactions, the introduction of RB into kefir could improve these interactions [9, p. 543]. [10, p. 32] reported that the yoghurts added with inulin and peach dietary fiber had significantly higher apparent viscosity than the plain yoghurt.

On the other hand, [11, p. 2] reported that an increasing levels of addition wine grape pomace as prebiotic in yoghurts decreased apparent viscosity values. Also, [12, p. 9] stated that increasing the concentration of pomegranate peel extracts decreased the viscosity values and they associated these results with effect of pomegranate peel extract on the aggregation of network in yoghurts via electrostatic interactions.

The storage period could significantly affect the apparent viscosity of samples. For all the samples, the apparent viscosity showed a trend of rising first and falling later, the apparent viscosity was the highest on the 14$^{th}$ day, which showed that the best storage period of kefir should be no more than 14 days.

**Table 2**

**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) | K | 64.17±3.86$^{e, C}$ | 702.83±3.01$^{c, B}$ | 1023.33±17.74 $^{c, A}$ | 1095.83±80.01 $^{d, A}$ | 1003.33±147.95 $^{c, BC}$ |
| | A | 131.20±1.06 $^{d, C}$ | 1284.33±73.05 $^{b, A}$ | 1211.83±32.04 $^{c, A}$ | 1322.5±49.94 $^{c, A}$ | 988.75±5.30 $^{c, BC}$ |
| | B | 243.33±20.23$^{c, D}$ | 1605±10.00 $^{a, B}$ | 2645±45.83 $^{b, A}$ | 1536.67±46.46 $^{b, B}$ | 1210.83±45.85 $^{bc, A}$ |
| | C | 716.00±41.94$^{b, D}$ | 1758.17±3.55 $^{a, BC}$ | 2958.3±315.29 $^{a, A}$ | 2070.83±5.20 $^{a, B}$ | 1446.67±52.70 $^{b, C}$ |
| | D | 1861.25±15.91 $^{a, AB}$ | 1824.3±239.64 $^{a, B}$ | 3413.33±65.06 $^{a, A}$ | 1525.83±9.46 $^{b, B}$ | 1930±56.57 $^{a, B}$ |

$^{a, b, c, d, e}$ Means in the same column with different superscripts significantly differ (P<0.05)

$^{A, B, C, D, E}$ Means in the same row with different superscripts among kefir samples significantly differ (P<0.05)

SD: Standard deviation

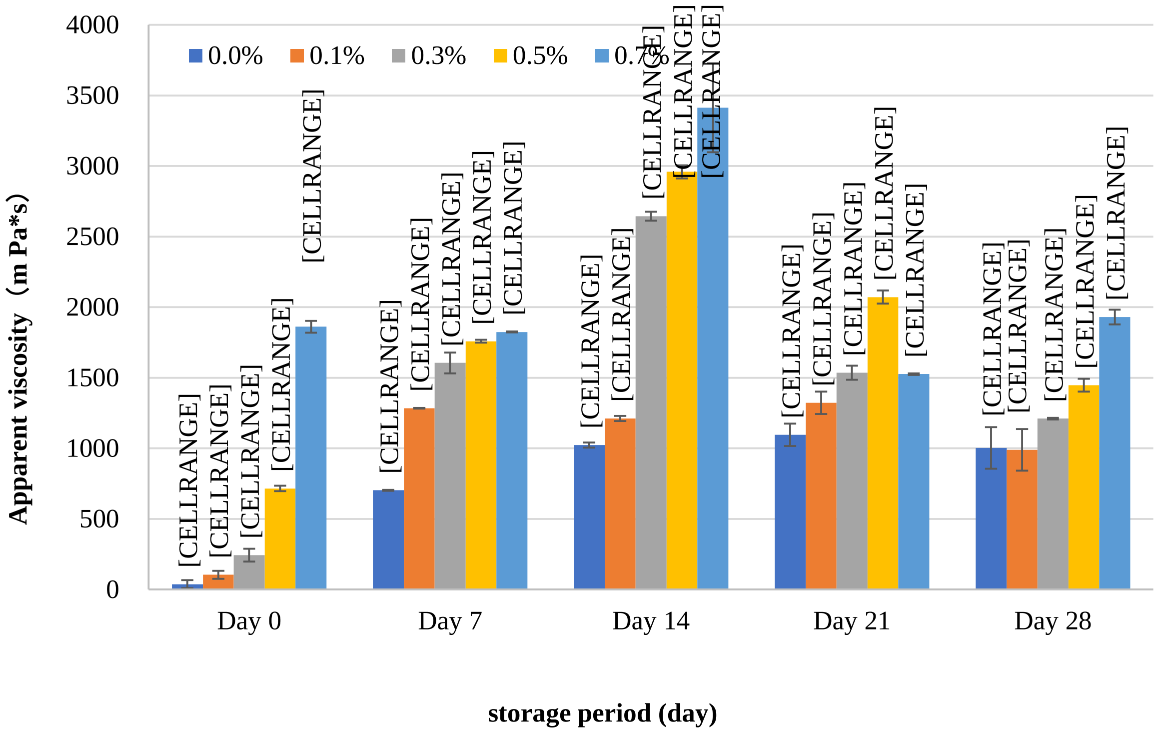


**Fig. 2. Apparent viscosity of kefir samples in 28 days**

* a, b, c, d, e Means in the same column with different superscripts significantly differ (P<0.05)

* A, B, C, D, E Means in the same row with different superscripts among kefir samples significantly differ (P<0.05)

* SD: Standard deviation

**Conclusion** The introduction of RB could increase WHC of kefir significantly (P<0.05), storage period made no significant difference on WHC (P>0.05) except for the first week. The introduction of RB could increase the apparent viscosity significantly (p<0.05), the more RB was added, the higher apparent viscosity was. Storage period influenced the apparent viscosity significantly (p<0.05), 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.

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