

Study on Quality Parameters of Yoghurt Fortified With Honey Bee

P. Purevsuren¹, D.Dashmaa^{2*} and N.Sarandagina²

¹Department of Livestock Production & Monitoring and Inspection, Mongolian University of Life Sciences

²Department of Coordination for Food Production Policy Development, Ministry of Food, Agriculture and Light Industry of Mongolia

*Corresponding author:

D.Dashmaa

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Abstract: Changes in physical, chemical, microbial and sensory properties of yoghurt enriched with honey were evaluated. The yoghurt was made from cow's milk and milk fortified with 5, 10 and 20% natural honey bee. Results showed that the physical and chemical contents of milk and natural honey are in good agreement with results in relevant standards. Natural honey was with high quality. Overall means of pH value of fortified yoghurt decreased (4.98 to 4.55) as the concentration of fortification percent increased. Titratable acidity was 68-71°T for yoghurts. The total solid contents of the yoghurt significantly increased with honey concentration. Total bacterial count of in yogurt was 256 at concentration of 10⁵ cfu/g, while 22 at 10⁶ cfu/g. There was not bacteria growth at 10⁷ cfu/g. Addition of honey improved the texture/clarity, color and flavour of the yoghurt. According to the obtained results we conclude that yoghurt of acceptable chemical, and sensory properties can be prepared using 10% natural honey. Fortifying of yoghurt with honey bee could be important for its beneficial effects on the human health and well being.

Keywords: Fortified yoghurt, Honey bee, Sensory.

INTRODUCTION

Yogurt is an important dairy product, particularly for consumers with lactose intolerance. It is considered a healthy food because it contains viable bacteria that are considered probiotics [1]. In recent years, there has been increasing interest in the use of natural and healthy food additives and incorporating health promoting substances into the diet due to its healthy and natural image. Honey in combination with milk provides an excellent nutritional value and it is recommended use for children as a main source of nutrition. Moreover honey could be a suitable sweetener for manufacturing fermented dairy products such as yogurt [2].

Furthermore the profile of honey in the health and food shopping list is rising. The reason for this increased demand for natural honey is attributable to its popularity due to several medicinal uses that this substance has enjoyed throughout the history of mankind. It has been observed from time immemorial that natural honey is not important for its medicinal attributes, but also natural beauty agent [3]. Besides its

sugar composition, honey consists of a number of bioactive compounds such as phenolic compounds, flavonoids, carotenoid-like derivatives, organic acids, Maillard reaction products, catalase, ascorbic acid, and other compounds which function as antioxidants [1].

In terms of Mongolia, the dairy industry is continually searching for products with high quality and stable properties due to the increasing interest of consumers not only in nutritious and tasty foods but also in products with specific characteristics that provide health benefits as well.

Nowadays, variety of enriched yogurt are sold entirely on the domestic market, but science-based studies on the technology or properties of dairy products enriched with honey bee are lacking in our country. Thus, purpose of this work was to study of the possibility to develop new yoghurt technology which enriched by natural honey as a sweetener and to evaluate the composition, quality, sensory, nutritional and health values of this yoghurt.

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MATERIALS AND METHODS

Yoghurt was prepared from fresh cow's milk with 4.2% fat content (3.2% proteins, 4.6% sugar, 0.65% minerals), obtained from state farm "Atar" of Tuv province.

Natural honey bee was purchased from "Khalkh goliin khishig" LLC of Khalkh gol sum, Dornod province. The yoghurt manufactured by using classic pure lactic acid starter (Hansen, Germany) and fortified with 5, 10 and 20% honey bee, respectively (Table 1) in dairy processing plant 'Bambuulai' of Mongolian University of Life Sciences.

Table1. Formula of yoghurt enriched by honey bee

Raw materials	Formula		
	5%	10%	20%
Cow milk, l	10	10	10
Honey bee, g	500	1000	2000
Lactic acid starter, g	0.12	0.18	0.20

Physical, chemical and microbiological characteristics of milk samples and yoghurt were entirely in accordance with the pertinent standards. Each analysis was done by three replicates in laboratories "Dairy science" and "Feed analysis" of School of Animal Science and Biotechnology, MULS:

- Milk physical and chemical analyses- by Lactoscan milk analyzer SP [4].
- pH of milk-by pH-meter (Seven compact, Mettler Toledo)
- Moisture content - drying method, MNS 401:75

- Acidification in milk – by titration method, MNS 400:83
- Total protein content in yoghurt - by Kjeldahl method, MNS 2950:83
- Total fat analysis - by MNS 399:83
- Sugar - by polarimetric method
- Dry matter in yoghurt - by drying method, MNS 401:75
- Moisture content in honey - by refractometer
- The inverted sugar or sucrose content in honey - by photoelectric colorimeter
- Microbiological analysis -The standard plate count technique was used to enumerate the total bacterial count of yoghurt. MNS ISO 1102:70
- The sensory evaluation of the products was done following the standard MNS ISO 707-2000 [5] and evaluation was profiled after the 1st and 7th day in the cold store.

Yoghurt was then evaluated by totally 150 consumer panelists who were mainly 18-55 year of age with being frequent dairy consumers.

Statistical analysis: Statistical analysis was carried out by SPSS 16.0 (SPSS Inc., IBM, USA) program package. Results were reported as mean \pm standard deviation.

RESULTS

Results of sensory evaluation showed that both raw materials; milk (Table 2) and honey bee (Table 3) were with high quality. Milk was white to white yellow, equable fluidity with silky texture, with natural acceptable aroma and without precipitation.

Table 2. Physical and chemical contents of milk compared to standard rating

Characteristics	Requirement of the standard MNS 4228:2011	M \pm m	σ	Cv%	Lim
Fat, %	3.2-5.4	4.2 \pm 0.14	0.29	7.0	3.5-4.4
Protein,%	3.1-3.7	3.2 \pm 0.01	0.01	0.2	3.2-3.2
Sugar,%	-	4.6 \pm 0.01	0.01	0.03	4.5-4.6
Minerals,%	-	0.65 \pm 0.01	0.03	4	0.6-0.7
Dry matter without fat,%	9.0-9.9	9.1 \pm 0.5	1.07	10	8.5-9.7
Density, $^{\circ}$ A	27-32	30.9 \pm 0.04	0.07	0.2	29.7-31.8
Freezing point, $^{\circ}$ C	-	-0.55 \pm 0.02	0.02	3	0.5-0.6
Titrateable acidity, $^{\circ}$ T	17-21	21 \pm 0.5	1	5	20-21

The values are the mean of 3 replications \pm SE

Chemical content such as protein, fat, sugar and mineral content of milk were 3.2, 4.2, 4.6 and 0.65% respectively. While physical characteristics including

density was 30.8 $^{\circ}$ A, freezing point was -0.55 $^{\circ}$ C, and titrateable acidity was 21 $^{\circ}$ T.

Table 3. Sensory evaluation of the natural honey compared to standard rating

Characteristics	Requirement of the standard MNS 6294:2011	"Khalkh gol" natural honey bee
Color	Pale yellow to dark brown	Hazel and yellowish
Texture/clarity	Equable, clear, pure, no layer stripe, no precipitate, acceptable little crystalized form	Equable, clear, pure, no layer stripe, no precipitate
Odor	Bees wax fragrant odor	Bees wax fragrant odor
Taste	Specific sweet taste	Sweet
Oxidation	should not be	not detected
Mechanical contamination	should not be	not detected

Honey bee color was yellow, pure without layer stripe and precipitation, with own specific sweet taste and bees wax fragrant odor. Product was with high quality and was not oxidation, mechanical contamination and foaming.

Table 4. Heavy metals and radioactive substances level in honey bee compared to standard threshold level

Heavy metals and radioactive substances	Acceptable maximum level of the standard	“Khalkh gol” natural honey
Plumbum(Pb),mg/kg	1.0	0.118
<i>Arsenic</i> (As), mg/kg	0.5	0.0001
Cadmium(Cd), mg/kg	0.05	0,0002
Cesium (Cs) -137, Bq/kg	20	-
Strontium (Sr) -90, Bq/kg	15	0.27

The concentration for heavy metals including, Pb was 0.12, As was 0.0001 and Cd was 0.0002 mg/kg and radioactive substance strontium Sr-90 0.27 Bq/kg in

honey bee. This level was much lower than acceptable maximum level of the standard. Moreover cesium (Cs)-137 not detected in honey.

Table 5. Physico-chemical contents of natural honey bee compared with the results of other researchers

Characteristics	“Khalkh gol” natural bee	Fennel honey [5]	Fennel honey [6]
Inverted sugar,%	96.6	70.4	82.8
Sucrose content,%	7.6	-	-
Moisture,%	21	26.4	17.2
Protein,%	0.24	0.25	0.2
Titrateable acidity, °T	3	-	-

The titrateable acidity of yoghurt did not differ ($p \leq 0.05$) between honey concentrations and overall means of titrateable acidity was 68-71°T for yoghurts, it was similar the scale in relevant standard [6].

However pH value of fortified yoghurt decreased (4.98 to 4.55) as the concentration of fortification increased, because honey contains organic acids which increase the acidity and acidity of

ingredients affects acidity of yoghurt [5, 6]. The total solid contents of the yoghurt samples significantly increased with honey concentration.

Results of sensory evaluation were shown in Figure 1 and 2. In terms of flavour evaluation test, the yoghurt supplemented with 10% honey bee gained the highest score (76 consumers, 50.6% of total). Many consumers preferred for it is well-adjusted flavor of honey and suitable firmness, sweet taste and fragrant odor.

Table 6. Composition of of yoghurt enriched by honey bee

Characteristics	Formula		
	5%	10%	20%
pH	4.98	4.69	4.55
Titrateable acidity, °T	71±0.01	69±0.01	68±0.01
Calorie, kcal	40.3±0.1	37.9±0.13	39.4±0.1
Dry matter, %	16.9±0.01	21.6±0.03	25.9±0.05
Moisture,%	83±0.02	78.4±0.02	74.1±0.02
Fat, %	3.74±0.03	3.08±0.02	2.64±0.02
Protein, %	3.84±0.03	3.09±0.02	2.84±0.02
Sugar,%	4.63±0.02	5.18±0.01	6.02±0.01

The sensory attributes consisted of flavor, odor, general appearance, color and consistency (clarity). The sensory scores were awarded for each attribute using a rating scale ranging between 0 and 100. Total 55 consumers (36.6%) preferred yoghurt with 5% honey bee, for firmness and color which were suitable for drinking. Consumers also noted that addition of 5% honey was not improved yoghurt flavor

as a honey taste. Yoghurt added 20% honey received the lowest score (12.6%).

The knowledge obtained from this study could be applied for the development of a novel formulation for functional food enriched with honeybee.

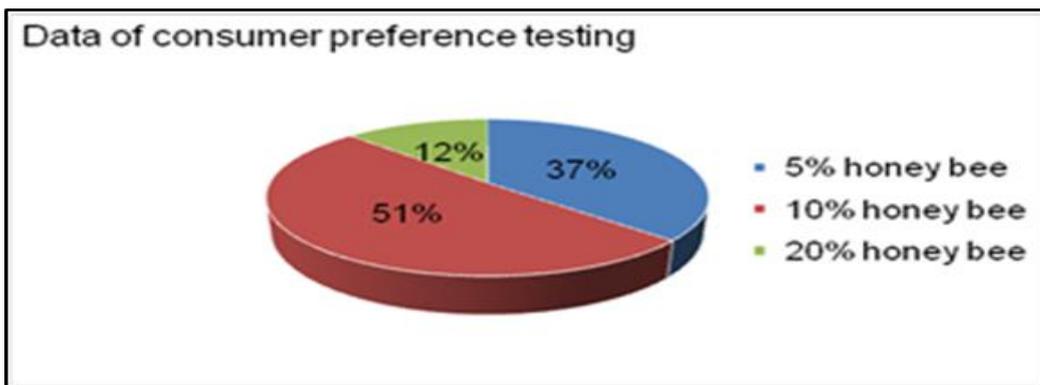


Figure 1. Consumer preference for different enrichment level

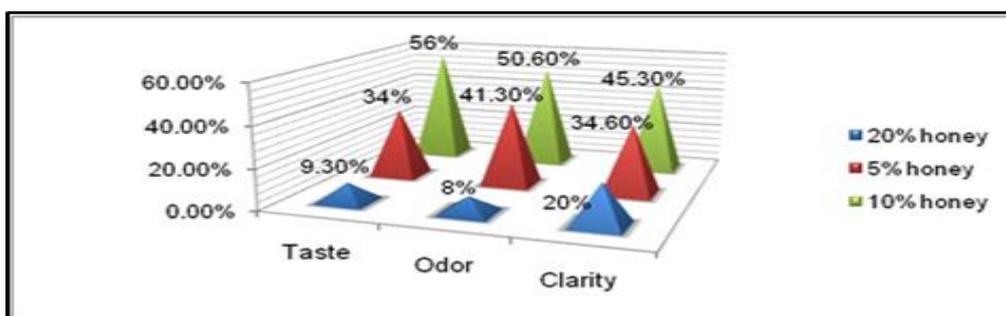


Figure 2. Consumer preference of enriched honey yoghurt for sensory attributes

The standard plate count technique was used to enumerate the total bacterial count of honey enriched yoghurt at 10%. As shown in Figure 3, the total

bacterial count in yogurt was 256 at concentration of 10^5 cfu/g, while 22 at 10^6 cfu/g. There was no bacterial growth at 10^7 cfu/g.

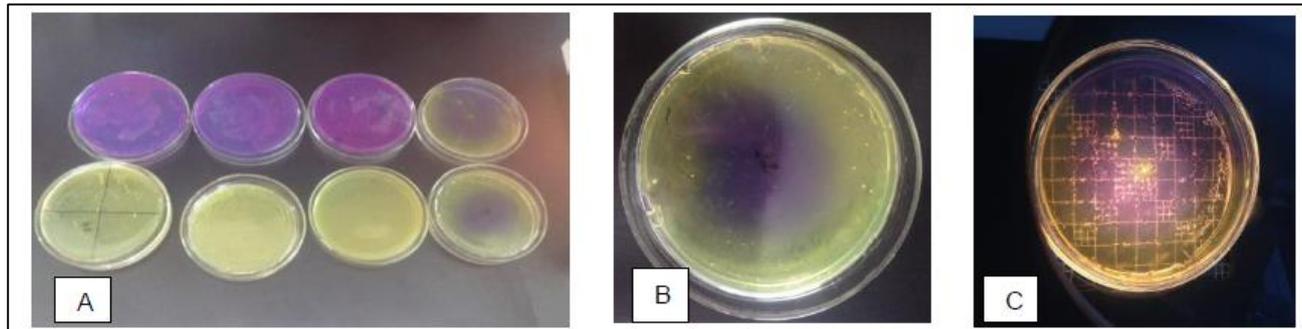


Figure 3 A) Counts of total bacteria in honey enriched yoghurt at 10%; B) At concentration of 10^6 cfu/g, C) At concentration of 10^7 cfu/g (no growth)

DISCUSSION

Titrate acidity was 68-71°T for yoghurts, it was similar the scale published in relevant standard [6]. The range for acidity 70-1200T of yoghurt was established by this standard. Overall means of heavy metals and radioactive substances in honey bee are falling within the scale published in relevant standard [5]. The results of moisture and protein of honey are also in agreement with the finding of Bakr *et al.*, [7], Ghadge *et al.*, [8], while Inverted sugar was little higher than result of researchers compared. Honey contains roughly 0.5% proteins, mainly enzymes and free amino acids [3]. Furthermore the quality of honey depends on its chemical composition and floral origin. The composition of active components in plants depends on various factors, particularly on plant bio-, chemotype

and climatic conditions. Consequently, it can be reasonably expected that honey properties from different locations should be different [3, 5, 9, and 10].

CONCLUSION

Fortifying of yoghurt with honey bee is could be important for its beneficial effects on the human health and well being. According to the obtained results we conclude that yoghurt of acceptable chemical, microbiological and sensory properties can be prepared using 10% natural honey. It highly improves sensory characteristics without having an inhibitory effect on starter bacteria. The total solid contents of the yoghurt samples significantly increased with honey concentration. Honey-sweetened products are viewed as value-added and consumers are willing to pay up to

13% more for them compared to products containing other sweeteners, thus calculate the unit *cost* is would be an important aspect of production. Further studies might be required to bioactive compounds or antioxidants content of honey enriched yoghurt.

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