Agricultural Sciences Journal
Available online at http://asj.mnsuam.net/index.php
ISSN 2707-9716 Print
ISSN 2707-9724 Online

Research Article

Impact of Hydrocolloids on Physicochemical and Sensory Attributes of Goat Milk Yoghurt

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ABSTRACT

Goat milk has unique nutritional and therapeutic properties that make it a valuable animal product. In the present study goat milk was utilized for the preparation of yogurt using guar gum (0.5, 1, 1.5 and 2%) value addition. Goat milk was evaluated for physicochemical analysis and yoghurt was prepared by using hydrocolloids. The prepared yoghurt was subjected for the assessment of various physicochemical analyses like synersis, pH, acidity and viscosity. The proximate composition of the guar gum such as moisture, crude protein values, crude fat contents, crude fiber proportion, ash percentages and nitrogen free extracts were analyzed to qualify the final product attributes. in the present study in which guar gum results observed that contain 11% moisture content and protein 4.46% while crude fiber was found 1.92%, 0.73% ash and 0.30 crude fat contents. The pH of the prebiotic yoghurt showed that T0 Control yoghurt has largest value 4.52 at 0 day as compression to T4 2% guar gum. the pH and viscosity was decrease with passage of time. While acidity synersis was increased during storage periods. The effect of guar gum on sensory evaluation has a significant effect, as color and taste was decrease and aroma increase with the passage of time. During the current study it was observed that addition of guar gum as functional ingredient has substantial effect on product developed for value addition.

Keywords: yogurt, hydrocolloids, synersis

(Received: 29 October 2020, Accepted: 25 December 2020) Cite as: Rehman, A, U., Shahbaz, M., Farooq, U., Amin, M. 2020. Impact of Hydrocolloids on Physicochemical and Sensory Attributes of Goat Milk Yoghurt. Agric. Sci. J. 2(2): 1-8.

1. INTRODUCTION

Dairy products are the main supply of milk in which goat milk contributes 2% world's production annually. It has unique nutritional properties and easy to digest than other milks (Haenlein,2004). The consumption of milk like buffalo and cow milk have a great importance but the goat milk has become a prospect to diversify the dairy needs. Goat milk is known for its good functional and nutritional characteristics like digestibility and providing essential nutrients to the human body (Ohiokpehai, 2003). In modern Asian countries almost 809 million of goats are present in which nearly 86% of that population is present in low income areas. Asia only produces about 80 % goat milk in which main countries are Bangladesh, Pakistan, Turkey, Iran, China and India (Singh *et al.*, 2008). Prebiotic is the short chain carbohydrates which is non-digestible by digestive enzymes in human and known as a resistant starch. A food source especially for the existing micro biome and for probiotics (Abu Shanab and Quigley, 2009).

Guar (*Cyamopsis tetragonolobus*) is annual crop belong to family *laguminosae*. Usually it is cultivated in semi-arid and arid region. The height of guar plant is nearly 0.6m and it is mostly similar to the soybean plant and its pods are arranged in the vertical

form. The pods measuring 5-6 spherical, 5-12.5 cm vertical and it contains light brown seeds. Around the world hydrocolloids are produce in large amount for the different purposes in the industries. (Chudzikowski 1971).

Guar meal is also known as a collection germ and hull of seed which has contain a huge amount of protein. Guar gum Powdered composition is followed by 75-86% water soluble galactomannan, 8-14% moisture, 5-6% protein, 2-3% fiber and 0.5-1% ash. Main application areas of guar gum and its derivatives are oil and gas well fracturing, food, cosmetics, mining industries, paper, explosives and textiles (Seaman, 1980). Approximately 90% of the guar gum is cultivated in Pakistan, India, Brazil, Australia, USA and South Africa. The production of guar gum is estimated 15,000 MT annually. Before 90s, Pakistan grown about 80% guar in irrigated areas therefore yield per hectare in that time was h igher. The guar was grown in Punjab, mianwali, muzaffargarh, Sargodha, Bahawalpur, Multan and include the province Sindh (Mudgil *et al.,* 2011). Prebiotic have been added to plain yoghurt in Tanzania to improve their consumption. These prebiotics suppressed the sour taste of yogurt without sweet addition profile of the product to increase the final product acceptability (Allgeyer *et al.,* 2010). It has also many others positive effect on final product attributes such as sensory acceptance, texture and fiber contents of the product.

2. MATERIALS AND METHODS

The current study was planned in the Central Laboratory of the Muhammad Nawaz Shareef University of Agriculture Multan including microbiology and bio safety research lab. Yoghurt containing prebiotic effect was processed to assess the role of guar gum on structure and functional properties of the yoghurt.

2.1 Raw materials handling

All raw materials were procured from the local store and stored at room temperature for execution of the analysis while goat milk procured from the surrounding of MNS-UAM for further use. All the reagent and chemical were made available in Laboratory of Central Lab System of MNS-UAM.

2.2 Proximate composition of guar gum

The guar gum powder was purchased from the local market of Multan and stored at the room temperature in the laboratory of Food Science and Technology MNS-UAM. The proximate composition of the guar gum was measured according to follow the protocol of AACC (2000).

2.3 Product development

The goat milk was pasteurized at 85℃ for 30 mints and the temperature down to 50℃. After that the guar gum powder is add in milk at different levels (0.5, 1, 1.5 and 2%) and homogenized on 50℃ at 1000 rpm for two mints and heat at 90℃ for 10 mints. After this inoculation done with yoghurt starter culture for 6 hours at 42℃next the prebiotic yoghurt was stored at 4℃ for 24 hours.

2.4 Physico-chemical analysis of prebiotic yoghurt

2.4.1 Determination of pH

According to protocol (AOAC, 2000) the pH of prepared yoghurt was measured by digital pH meter. Calibration is done before measurement. Take an adequate amount of yogurt sample in a beaker and pH meter was dip and reading was recorded.

2.4.2 Acidity determination

The acidity of the prepared yoghurt was analyzed with 10 ml sample was homogenized with dilution of 20 ml distilled water. Take2-3 drops of phenolphthalein indicator were used and titrate until the end point light pink color appeared. Prebiotic yoghurt acidity was calculated according to protocol as described through AOAC (2000).

2.4.3 Viscosity

Viscosity of prepared yoghurt was estimated using viscometer according to method adopted by (Hassan *et al.,* 2016). By using a Brookfield LVDVE-230 (MA, USA) viscometer. Yoghurt is continuously agitated for the measurement of viscosity and at 10 to 15℃ viscosity of yoghurt is determined. Before viscosity measurement yoghurt was stirred for 40 seconds with the rotation of 10 rpm spindle number 4 was used for this calculation. In centipoises (CPU) units and percent torque viscometer reading was noted.

2.4.4 Syneresis

The water releases from yogurt samples after setting the curd was examined by the method of (Rodarte *et al.,* 2004). 5 ml of yoghurt was centrifuged at 5000 rpm for 20 min at 4°C and separated whey was measured after 1 min. Amount of whey separation was expressed as volume of separated whey per 100 mL of yoghurt.

2.4.5 Sensory assessment

Sensory properties of prebiotic yoghurt was checked at 0, 7 and 14 days by the panel lists of Department of Food Science and Technology, MNS-UAM using hedonic scale according to method of (Jadhave and Pawar 2016).

2.5 Statistical Analysis

Two factor factorial analysis with completely randomized design (CRD) was performed for storage data using software Statistix 8.1. (Steel *et., al* 1997).

3. Results and discussions

3.1 Guar gum nutritional profiling for composition

The proportion analysis of nutrients of guar gum powder demonstrated in the table 4.1. The guar gum powder result observed that contain 11% moisture content and protein 4.46%. The crude fiber was found 1.92%, 0.73% ash and 0.30 crude fat.

During this study the proximate analysis of guar gum was observed in mean table. The mean values of the proximate compositional analysis of guar gum moisture content, fiber, crude ash, fat contents, protein percentage and NFE found to be 11.0±0.09, 4.46±0.04, 1.92±0.04, 0.73±0.03, 0.30±0.02 and 81.41±0.07 respectively. The results in current research study are similar to mudgil et al., (2018).

Table 3.1. Mean of proximate omposition of guar gum.

Ingredients in guar gum	Mean values
Moisture %	11.0±0.09
Ash%	0.73±0.03
Protein%	4.46± 0.04
Fat%	0.30±0.02
Fiber%	1.92±0.04
NFE%	81.41±0.07

3.2 pH of prebiotic yoghurt during storage

Mean value for the influence in treatment on pH of prebiotic yoghurt showed that T_0 (Control yoghurt) has largest value 4.52 at 0 day as compression to T_4 (2% guar gum prebiotic yoghurt) where lowest value was observed 3.94 at 14 of storage study as indicated in the table. The overall values of mean of the result as 4.36, 4.29, 4.26 and 4.21 for treatment T_0 to T_4 respectively.

The current results are similar to the work with of Cruz *et al.,* (2013) who reported that the storage time has significant effect on pH. They documented that decrease in pH during storage of yogurt was as result of formation of lactic acid by the activity of lactic acid bacteria. Consequences of the current project are in line with the findings of Mazloomi *et al*., (2011) who inferred the pH of yogurt was decreased during storage.

3.3 Acidity

Statistical values for Acidity percentage observation were observed as highly significant for storage. The value for the influence on Acidity of prebiotic yoghurt showed that T_4 (2% guar gum prebiotic yoghurt) has largest value 1.25 at 14 of storage study as compression to T_0 where lowest value was observed 0.86 at 14 of storage study as shown in the table.

The Results of current research are in line with Karaca *et al*., (2013) who studied physicochemical and sensory attributes of probiotics yogurt manufactured by adding stabilizers and investigated that the acidity of yogurt increased with storage period. Gueimonde *et al.,* (2003) also concluded that with the passage of time the acidity of yogurt increased due to microbial activity and lactose change into lactic acid.

3.4 Viscosity

Statistical values for viscosity percentage observation were observed as highly significant for storage. The suggest value for the influence of treatment on viscosity of prebiotic yoghurt showed that T_0 (control sample) has lowest value 1695 (cps) at 14 day of storage study as compression to T_4 (2% guar gum prebiotic yoghurt) where highest value was observed 4861 (cps) at 0 of storage study as described in table. the overall means of the result as 1911.67, 3246, 3788.33, 4022 and 4494 for treatment T_0 to T_4 respectively.

The difference in viscosity due to storage time is linked to recorded findings of Ramasubramanian *et al.,* (2008) who observed a decrease in viscosity due to increased of synersis during storage of probiotic yoghurt. In another study the reduction in the viscosity of yogurt during the progression of storage time can also be explained by enzymatic activity of bacteria on the casein micelle matrix. Aryana *et al.,* (2007).

3.5 Synersis

Statistical values for synersis percentage observation were observed as highly significant for storage. The mean value for the influence of treatment on Syneresis of prebiotic yoghurt showed that T_0 (control sample) has largest value 27.28 at 0 day of storage study as compression to T_4 (2% guar gum prebiotic yoghurt) where lowest value was observed 24.81 at 14 of storage study as described via table. the overall mean of the result as 47.22, 63.67, 64.33, 69.00and 72.67 for treatment T_0 to T_4 respectively.

These findings are similar to the result of Bahrami *et al*., (2013) who found that The addition of guar gum significantly increased the Syneresis of yogurt samples. The reason for this may be related to the optimal pH difference of the activity of guar gum with yoghurt pH. Aryana *et al.,* (2007). Also reported same results that synersis increase with the passage of time.

Table. 3.2 Means values of physicochemical analysis of prebiotic yoghurt during period of storage

pH			
Treatment	0 day	7 days	14 days
T_0	4.52 ±0.02a	4.41 ±0.02c	4.31 ±0.02efg
T_1	4.45 ±0.02b	4.32 ±0.02ef	4.27 ±0.02fgh
T_2	4.43 ±0.20c	4.31 ±0.02de	4.26 ±0.02gh
T_3	4.41 ±0.03c	4.29 ±0.02hi	4.24 ±0.02i
T_4	4.38 ±0.02d	4.28 ±0.02hi	4.20 ±0.02j
Acidity			
T_0	0.98 ±015i	1.04 ±0.02h	1.06 ±0.01gh
T_1	1.00 ±017h	1.08 ±0.01fg	1.11 ± 0.01d
T_2	1.06 ±02gh	1.12 ±0.15de	1.14 ±0.02cd
T_3	1.09 ±01ef	1.15 ±0.015bc	1.17 ±0.02b
T_4	1.14 ±02d	1.16 ±0.017b	1.20 ±0.01a
Viscosity			
T_0	2075 ±0.53i	1965±70.12i	1695±75.22n

T_1	3440±120.13i	2995±80.56k	3265±91.15j
T_2	4835±140.09f	4570±130.07g	4350±121.22h
T_3	4570±132.01c	5585±145.32d	5390±138.05e
T_4	6050±153.76a	5960±148.15b	5940±150.16b
Synersis			
T_0	39 ±2i	45 ±2h	58 ±1.52fg
T_1	55 ±2g	63 ±1.52e	72 ±1.52b
T_2	59 ±1f	65 ±1.52e	70 ±1.52cd
T_3	64 ±2e	68 ±1d	74 ±1.52b
T_4	68 ±1.52d	72 ±1.52bc	78 ±1.52a

T_0: Control sample, T_1= 0.5% guar gum prebiotic yoghurt, T_2= 1% guar gum prebiotic yoghurt, T_3= 1.5% gar gum prebiotic yoghurt and T_4= 2% guar gum prebiotic yoghurt

3.5 Sensory Analysis of yoghurt:

3.5.1 Color

Color is the more significant specification to convince the customers either product is acceptable or rejected. Color is most important intrinsic factor which affects the quality of product. Statistical values for color observation were observed as highly significant for both treatments and storage. The values for the influence on color of prebiotic yoghurt showed that T_0 (control sample) has largest value 7.00 at 0 day as compression to T_4 (2% guar gum prebiotic yoghurt) where lowest value observed 6.18 at 14 day of storage study as described in the table. the overall mean of the result as 6.85, 6.81, 6.69, 6.53and 6.29 for treatment T_0 to T_4 respectively.

The current result is in line with the result of Rafiq *et al.,* (2020) who found that color scores decreased during the storage time from 7.57 at 0 day to 6.21 at 21st day of storage.

3.5.2 Aroma

Aroma is the typically smell, odor or fragrance of product which convince to consumers. Statistical values for Aroma observation were observed as significantly maximum for both treatment and storage. The mean value for the influence of treatment on aroma of prebiotic yoghurt showed that T_0 (Control yoghurt) has largest scores (6.50) at 0 day as compression to T_4 (2% guar gum prebiotic yoghurt) where lowest score was observed 4.60 at two weeks table. The overall mean of the result as 5.94, 5.82, 5.68, 5.52 and 5.34 for T_0 to T_4 respectively.

3.5.3 Taste

A sensation of flavor of any substance or food product perceived in sensory buds in mouth is known as flavor. Statistical values for taste observation were observed as substantial for both concentration and time durations. The mean value for the influence of treatment on taste of prebiotic yoghurt showed that T_0 (Control yoghurt) has largest scores 6.70 at 0 day as compression to T_4 (2%guar gum prebiotic yoghurt) where lowest score was observed 5.08 at two weeks study showed in the table . the overall mean of the result as 6.34, 6.24, 6.11, 5.99 and 5.76 for T_0 to T_4 respectively.

Tarakci and Kucukoner (2003) found a decreased taste perception of yogurt during 10 days of storage at 5°C while studying different characteristics of fruit flavored yogurt. In another study According to Bano *et al.,* (2011) the taste of the yoghurt is decreased with passage of time.

3.5.6 Softness

Softness is the quality of smoothness or being cut or compress. Statistical values for softness observation were observed as significantly maximum for both storage and treatments The observed values of influence of treatment on softness of prebiotic yoghurt showed that T_0 (Control yoghurt) has largest scores 7.35 at 0 day as compression to T_4

(2%guar gum prebiotic yoghurt) where lowest score was observed 6.71 at two weeks study showed in the table. The overall mean of the result as 7.88, 7.75, 7.13, 6.59 and 6.51 for T_0 to T_4 respectively.

3.5.7 Overall consumer acceptability

In a larger aspect overall consumer acceptability is an element of product consistency. Flavor, color, appearance and its texture of final product and product mouth feel. Statistical values for overall acceptability observation were observed as significantly highest for both treatment and storage. The values of influence of treatment on overall acceptability of prebiotic yoghurt showed that T_0 (Control yoghurt) has largest scores 8.00 at 0 day as compression to T_4 (2% guar gum prebiotic yoghurt) where lowest score was observed 6.00 at two weeks of storage study showed in the table. The overall mean of the result as 7.27, 7.16, 7.09, 7.01 and 6.60 for T_0 to T_4 respectively.

Rezaei *et al.,* (2011) reported that guar gum and arabic gum at a concentration of 0.2% and 0.5% respectively exhibited the most favorable sensory assessments. In another study Irvine and Hekmat (2011) evaluated sensory properties of probiotics yogurt containing prebiotic fibers and stated that probiotics yogurt maintained a smooth, creamy, homogenous texture and received good sensory acceptability.

Table. 3.3 Means values of the sensory attributes of prebiotic yoghurt.

Color			
Treatment	0 day	7 days	14 days
T_0	7±0.05a	6.87±0.04c	6.68±0.35d
T_1	6.90±0.03ab	6.87±0.028bc	6.65±0.03d
T_2	6.88±0.05c	6.62±0.02de	6.58±0.02ef
T_3	6.62±0.02d	6.55±0.03f	6.41±0.05g
T_4	6.40±0.01g	6.30±0.02h	6.18±0.04i
Aroma			
T_0	6.50±0.03a	5.98±0.3e	5.33±0.25jj
T_1	6.38±0.04b	5.88±0.03f	5.20±0.02k
T_2	6.28±0.03c	5.72±0.02g	5.03±0.03l
T_3	6.10±0.03d	5.59±0.02h	4.88±0.04m
T_4	5.95±0.03e	5.48±0.02i	4.60±0.03n
Taste			
T_0	6.70±0.03a	6.41±0.02c	5.92±0.03g
T_1	6.65±0.02a	6.30±0.02d	5.78±0.04h
T_2	6.50±0.04b	6.19±0.03e	5.63±0.01i
T_3	6.34±0.02d	6.10±0.04f	5.52±0.03j
T_4	6.24±0.03e	5.95±0.02g	5.08±0.06k
Softness			
T_0	7.35±0.52a	7.15±0.03c	6.95±0.03ef
T_1	7.27±0.04ab	7.12±0.05cd	6.98±0.05ef
T_2	7.20±0.05bc	7.00±0.06ef	6.88±0.05fg
T_3	7.04±0.6de	6.86±0.08h	6.72±0.03i
T_4	6.95±0.07ef	6.86±0.04gh	6.71±0.11i
Over all acceptability			
T_0	8.00±0.5a	7.70±0.35ab	7±0.15ab

T_1	7±0.69ab	7.30±0.17ab	7±0.15ab
T_2	7.5±00.5a	7±0.15ab	6.50±0.25cd
T_3	6.80±0.5ab	6.3±0.25ab	6.00±0.14de
T_4	6.70±0.25ab	6.60±0.20bc	6±0.2e

4. Conclusions

The finding of the present study is beneficiary from industrial point of view in order to develop the versatile dairy products having valuable influence on human health that provide healthy gut functions with a balance between bad bacteria and good bacteria disturbance in balance occurs due to certain diseases of infections and antibiotics intake in human life style. The symbiotic product thus formed contains probiotic and prebiotics in their composition and are helpful in maintaining this balance and thus stimulates the health of human beings in a positive way.

5. Acknowledgement

I am very thankful to my supervisor Assistant Professor Dr. Muhammad Shahbaz MNS-University Of Agriculture Multan for his kind guidance, assistance and endorsement from the very early stage of this research as well as giving me extraordinary experiences throughout the research work. This thesis would not have been possible unless his untiring support and sponsorship.

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