



Quality Assessment of Cottage Cheese Available in Peshawar, Pakistan

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ABSTRACT

The current study was carried out to evaluate the quality of cottage cheese available in different areas of Peshawar. The aim of the study was to assess the microbial, physiochemical and sensory characteristics of the selected cheeses. We found that cheese selected from Board bazar (40%) were maximally contaminated with *Salmonella* on MacConkey Agar and minimum were recorded in Tehkal Region (0%). On same Agar high percentage for *Escherichia coli* was observed in samples from Hashtnagri (40%) and on tryptose agar results were quite high for *Salmonella* as compared to *E. coli*. In physiochemical analysis high pH was observed in samples taken from Warsak Road (6.84) followed by Hashtnagri. High moisture content was observed in samples taken from Saddar Bazaar (51.70%) followed by Tehkal Region (50.94%) while the high Ash content was found in Charsadda Road (1.81%) samples followed by Hashtnagri (1.76%). The highest fat content was observed in samples taken from Chowk Yaadgar (17.92%) and maximum protein content was found in samples taken from Warsak Road (25.40%) followed by Hashtnagri (24.24%). In sensory analysis the maximum mean score of judges for color, Flavor, Texture and overall acceptability were observed in Board Bazaar (7.97) followed by University Town (7.89) and the minimum values were given to the samples taken from Hashtnagri (7.57). Hence it was concluded that the samples taken from Hashtnagri and Chowk Yadgar were mostly found contaminated with *Salmonella* and *Escherichia coli* and physiochemical properties as well as sensory qualities of cheese purchased from Charsadda road shows good results.

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Authors' Contribution

MM, MA, SBK and AS designed the study. MM, MA, SBK, FJ, MAK and AK executed the experimental work and analyzed the samples. MM, MAK, Amjad K, KP and IA helped in data analysis and article drafting.

Key words

Cottage cheese, *Escherichia coli*, MacConkey Agar, Physio-chemical, *Salmonella*.

INTRODUCTION

In the past few decades, food poisoning has become a very topical issue and bringing out a great deal of public attention throughout the globe. This is a result of emerging food borne pathogens that cause diseases in different countries. Microorganisms such as *Salmonella* species, *Escherichia coli*, *Staphylococcus aureus* and *Listeria monocytogenes* are reported as the most common food borne pathogens in many milk and milk product. Numerous numbers of microbial pathogens are there to contaminate human food, cheese and other dairy products

to cause illness when they and their toxins are consumed. These pathogens include *Salmonella*, *E. coli*, aerobes, anaerobes and enteric bacteria (Egbenni and Okolie, 2010).

Dairy products with respect to food borne diseases have great concern throughout the world. In developing countries where milk and various milk products takes place under unsanitary conditions and poor manufacturing practices (Samia et al., 2009). In order to protect public health against food borne infections, there are regulations which require a proper handling of milk, but in developing such regulations are not usually followed, and milk borne health risks become much higher in these countries (Donkor et al., 2007).

Over past few years many of cheese varieties has been produced from many sources and methods. Different cheeses were evaluated for their quality but less research

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has carried out on microbial, physiochemical and sensory aspects of local cottage cheeses. The aim of current study is to evaluate the quality (microbial, physiochemical and sensory) of cottage cheeses available in Peshawar.

MATERIALS AND METHODS

A total of 100 samples were randomly collected from different areas of district Peshawar during the month of June 2017. Ten each from Board Bazaar (BB), University Town: (UT), Tehkal Region (TR), Chowk Yadgaar (CY), Saddar Bazaar (SB), Hashtnagri (HN), Charsadda Road (CR), Dalazak Road (DR), Kohat Road (KR) and Warsak Road (WR). Samples were brought to the microbiology laboratory of Faculty of Animal Husbandry and Veterinary Sciences and analyzed for pH, ash content, moisture, protein content and fat content.

Media was prepared according manufacture instructions labeled on the packing of the agars (BD, Difco, France). Sterilization was done by autoclaving at 121°C for 15 min. MacConkey (212123) and Tryptose agar (DF0064-17-4) was used and both the strains were determined.

For identification of *Salmonella* and *E. coli*, 2 g of cheese sample was added to 225 ml buffered peptone water and incubated at 36°C ($\pm 1^\circ\text{C}$) for 18-20 h (1st incubation). 1 ml pre-enrichment broth was transferred to 10 ml tetrathionate broth and incubated at 36°C ($\pm 1^\circ\text{C}$) for 20 h (2nd incubation). 10 μl from of this broth was spread on MacConkey agar plates and incubated at 36°C ($\pm 1^\circ\text{C}$) for 18-20 h. Appearance of pink colour colony confirms the presence of *E. coli* in the sample and will produce red rings as indole positive. Typically *Salmonella* colony is colorless and transparent and do not alter the appearance of the medium. The % positive cases were calculated by the following formula:

$$\text{Positive sample (\%)} = \frac{\text{No. of positive samples}}{\text{Total No. of samples}} \times 100$$

Samples were used for the determination of pH, ash and moisture according to the standard method by Association of Official Analytical Chemist (2012). Sensory analysis was done by using nine points of Hedonic Scale of Poste *et al.* (1977). Statistical analysis of all parameters was carried out through complete randomized design (CRD). Means were separated by using LSD. Statistics was analysed through statistical software as designated by Steel and Torrie (1997).

RESULTS AND DISCUSSION

Microbial analysis

The % microbial presence on MacConkey Agar media for *Salmonella* and *E. coli* was calculated for

cheese samples collected from local areas of Peshawar (Table I). Significant difference was found in the 10 selected areas for the presence of *Salmonella* spp., the highest % presence was found in the samples collected from BB, SB and KR while the samples collected from DR and TR did not show the *Salmonella* presence. In case of *E. coli* % microbial presence was significantly different from one location to another; greatest was found in HN samples while UT, CR, DR and KR were found to be free of *E. coli*. On Tryptose Agar the highest percentage was observed in Hashtnagri (40 %) followed by Saddar Bazaar (20%) and the rest of the samples were found less positive or have shown negative results. While for *E. coli* maximum prevalence was observed in samples purchased from Saddar Bazaar followed by Hashtnagri and the rest showed negative results for *Salmonella*. The current study showed positive results for *Salmonella*. There could be a number of reasons for the presence of microbes in the cottage cheese. Nobili *et al.* (2016) reported the similar results that poor microbial quality of Italian cheese is maybe due to the poor and unhygienic practices during the preparation of Italian cheese. The results are also in line with those reported by Abdalla and Stafanie (2013) she reported that the presence of these pathogens may be due to internal consistency of these products. Similarly, Momtaz *et al.* (2013) observed approximately the same results in tap water samples taken from different location Isfahan city, Iran. He further claimed that there is a serious issue of drinking water contamination with *Salmonella* in Isfahan city.

Table I.- Microbial analysis of cheese samples collected from local areas of Peshawar.

Areas	MacConkey agar		Tryptose agar	
	<i>Salmonella</i> (%)	<i>E. coli</i> (%)	<i>Salmonella</i> (%)	<i>E. coli</i> (%)
BB	40 ^a	10 ^b	0 ^b	10 ^{bc}
UT	10 ^c	0 ^b	0 ^b	0 ^c
TR	0 ^d	10 ^b	0 ^b	0 ^c
SB	40 ^a	20 ^{ab}	20 ^a	20 ^{bc}
CY	30 ^{ab}	0 ^b	0 ^b	0 ^c
HN	20 ^b	40 ^a	20 ^a	50 ^a
CR	10 ^c	0 ^b	0 ^b	0 ^c
DR	0 ^d	0 ^b	0 ^b	0 ^c
KR	40 ^a	0 ^b	0 ^b	0 ^c
WR	30 ^{ab}	10 ^b	0 ^b	0 ^c
P-value	0.00E+00	2.73E-02	4.82E-02	4.00E-04
LSD value	0.1288	0.2424	0.1675	0.2495

Means followed by the same letters in the same column are significantly different at $P \leq 0.05$. BB, Board Bazaar; UT, University Town; TR, Tehkal Region; CY, Chowk Yadgaar; SB, Saddar Bazaar; HN, Hashtnagri; CR, Charsadda Road; DR, Dalazak Road; KR, Kohat Road; WR, Warsak Road.

Table II.- Physiochemical analysis of cheese samples from local areas of Peshawar.

Areas	pH	Moisture	Ash	Protein	Fat
BB	5.86 ^f	46.36 ^c	1.64 ^c	22.70 ^{de}	17.63 ^{ab}
UT	6.38 ^{cd}	50.94 ^a	1.58 ^c	23.40 ^{cd}	17.12 ^{cd}
TR	6.64 ^b	47.97 ^b	1.736 ^b	23.34 ^{cd}	17.39 ^{bc}
SB	6.33 ^d	51.70 ^a	1.72 ^b	23.47 ^c	16.76 ^c
CY	6.35 ^{cd}	45.18 ^c	1.47 ^d	22.19 ^e	17.92 ^a
HN	6.62 ^b	44.93 ^e	1.76 ^{ab}	24.24 ^b	15.80 ^f
CR	6.50 ^{bc}	46.09 ^{cd}	1.81 ^a	23.85 ^{bc}	17.01 ^{de}
DR	6.11 ^e	45.32 ^{de}	1.38 ^e	23.91 ^{bc}	17.12 ^{cd}
KR	6.16 ^e	39.36 ^f	1.78 ^{ab}	21.14 ^f	16.69 ^c
WR	6.84 ^a	47.56 ^b	1.60 ^c	25.40 ^a	16.94 ^{de}
P-value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LSD value	0.1655	0.0994	0.0753	0.0483	0.3175

For abbreviations and statistical details, see Table I.

Physiochemical analysis

Samples collected from different region were subjected to physiochemical analysis. The data indicated the significant difference for all of the physiochemical parameters (Table II). The highest pH (6.84) and % protein (25.40) were recorded for the samples collected from WR area and lowest pH (5.86) was observed for BB while lowest % protein (21.14) was in case of KR. The highest moisture (51.70 %) ash (1.81 %) and fat (17.92) were recorded in SB, CR and CY, respectively and lowest moisture (39.36 %) ash (1.38 %) and fat (15.80) were recorded in KR, DR and HN, respectively. The statistical analysis shows that the average value of physiochemical parameters obtained from different areas of Peshawar was significant ($P < 0.05$). This data revealed that source of milk has significant effect on the quality of cottage cheese, maximum mean value for pH was observed in WR followed by SB and this finding is justified by Razzaq (2003). He stated that the pH of milk and milk product is the indicator of superiority of milk products. Similar results were found by Khan and Masud (2013). They reported high pH values in cottage cheese prepared from buffalo milk it may be due to coagulating agent and enzymatic actions. The low pH may contribute to the longer shelf life of cheese (Seifu, 2012). It is concluded that pH plays a vital role in taste, coagulation and life span of cottage cheese. The current study concluded with highest moisture from 39.36 to 51.70 to and these outcomes resembles with the study of Khan and Masud (2013). They claimed that due to longer duration of coagulation, the rate of final moisture increases thus concluded that moisture content is influenced by time of coagulation which is important for the increased shelf

life of cottage cheese. Similar results were also observed in goat milk cheese by Mercanti *et al.* (2008); whereas Seifu (2012) has claimed that lower moisture content results in increasing the shelf life. Thus the overall results show that moisture content in cheese has significant effect on various cheese samples. The current study concluded with a highest ash content of 1.381 to 1.815 and these findings are according to the measures of Omotosho *et al.* (2011), who observed ash content of cheese similar to this current study. Omotosho *et al.* (2011) concluded that ash content can serve as a mineral part for human beings and may strengthen the brining effect during the manufacturing of the product. The average ash content of cheese in the current study for cow milk cheeses was in favor of Masud *et al.* (1992). Protein content between the ranges from 21.149% to 25.403% was observed. Athar *et al.* (2003) also reported the same results. They observed high protein content in cheese prepared from different sources of milk and claimed that protein content is influenced by the type of milk used for cheese production, health status and breed of an animal. This study concluded with a fat content between the ranges from 15.808 % to 17.922%. These findings resembles with the findings of Abd El-Gawad *et al.* (2007). During manufacturing of cheeses a proper ratio between protein and fat must be retained so that it affects the final properties of the product. When the drain of whey is completed it results in the loss of fats during the process which may be due to higher fat content milk selected for preparation of the cheese (Vishwishwaraish and Ananatakrisnan, 1986) so as a result it is concluded that increase or decrease fat content depend on milk type, source and its final yield (Masud *et al.*, 1992).

Sensory analysis

Cheese samples were analyzed for their sensory parameters. Analysis of the data showed the significant difference for different areas (Table III). The highest color value (7.97), flavor value (7.88) and texture value (8.70) were observed in the samples collected from BB, CR and WR, respectively. The lowest color value (7.57) was observed for HN while the lowest flavor value (7.56) and texture value (7.61) were recorded for BB. The highest overall acceptability value (8.08) were recorded for CR that was statistically similar to that of observed for DR and lowest (7.86) was recorded for UT. The statistical analysis of the data obtain for sensory parameters were significant for different areas of Peshawar was significant ($P < 0.05$). This study concluded with color content between the ranges from 7.57 to 7.97 by the panel judges. These results resembles with the findings of Park *et al.* (2007) who studied the effect on the color of cottage cheese prepared from sheep milk and cheese prepared from buffalo and

cow milk was reported more acceptable and score was range from 6.91 to 7.9. Moreover, the dullness and dry appearance in cheese may be due to the deficiency of fat. Similar results were reported by Boppanna (2007) and Masud *et al.* (1992) reported that appearance and color of cheese prepared from cow milk is more acceptable as compared to buffalo milk accordingly cheese color is influenced by fat content which decrease the dryness on the surface and increase its good look. Flavor content between the ranges from 7.56 to 7.88 was evaluated. These findings are in parallel with those reported by Soryal *et al.* (2004) who observed that cheese from goat milk has high score for flavor. He further reported that the FFA free fatty acid produce significantly cheese flavor and aroma. Similar results were found in cheese prepared from buffalo milk (Khan and Masud, 2013). Too much quantity of free fatty acid can cause unpleasant flavor in the final cheese which can lead to aggressiveness to the consumers (Soryal *et al.*, 2004). Our study recorded the acceptability of texture ranges from 7.97 to 7.61. These findings resembles with the results of Masud *et al.* (1992), who observed the texture of cow milk was extremely accepted over buffalo milk cheese. On the other hand, Karadbhajne and Bhoyarkar (2010) observed that fat, cheese yield moisture content as well as coagulant play vital role in cheese texture. They further reported that cheese texture is influenced by its shelf life. Park *et al.* (2007) analyzed firmness in low fat cottage cheese. However it is also concluded that cheese texture can be influenced by protein, moisture content, coagulant used, fat quantity and cheese yield. Elastic texture and firmness in cheese is because of low level of fats.

Table III.- Sensory analysis of cheese samples collected from local areas of Peshawar.

Areas	Color	Flavor	Texture	Overall acceptability
BB	7.97 ^a	7.56 ^c	7.61 ^c	7.95 ^{ab}
UT	7.89 ^{abc}	7.76 ^{abc}	7.75 ^b	7.86 ^b
TR	7.66 ^{ef}	7.77 ^{abc}	7.8 ^b	7.88 ^b
SB	7.73 ^{de}	7.85 ^{ab}	7.74 ^{bc}	8.07 ^a
CY	7.83 ^{bcd}	7.73 ^{bcd}	7.74 ^{bc}	7.97 ^{ab}
HN	7.57 ^f	7.81 ^{abc}	7.73 ^{bc}	7.94 ^{ab}
CR	7.87 ^{abc}	7.88 ^a	7.75 ^{bc}	8.08 ^a
DR	7.94 ^{ab}	7.71 ^{cd}	7.78 ^b	8.00 ^a
KR	7.8 ^{cd}	7.63 ^{de}	7.69 ^{bc}	7.96 ^{ab}
WR	7.63 ^{ef}	7.72 ^{cd}	7.97 ^a	7.93 ^{ab}
P-Value	0.00E+00	0.00E+00	0.00E+00	4.00E-02
LSD value	0.1299	0.1230	0.1368	0.1725

For abbreviations and statistical details, see Table I.

The statistical analysis shows that the average values obtained for overall acceptability cottage cheese taken from different areas of Peshawar was also significant ($P < 0.05$). The overall acceptability of the current study shows cross results with Darke *et al.* (2009) who observed very low acceptability values in cheese prepared from difference sources. Similarly, Boppanna (2007) observed the same low values in cheese prepared from organic and in organic sources. The study shows similarity to the values shown by Sadia *et al.* (2015) who observed higher acceptability values to cottage cheese prepared from different sources of milk.

CONCLUSION

From the current study it is concluded that the samples which were purchased from Hashtnagri and Chowk Yadgaar were mostly found contaminated with *Salmonella* and *Escherichia coli* on both agars and both the agars showed a good growth response and hereby suggested that may be used in future for further studies. The physiochemical properties of cheese purchased from Charsadda road shows good results among all the cheeses purchased. The sensory qualities (color, flavor, texture and overall acceptability) of the cheese purchased from Charsadda road showed high acceptability among the panel judges.

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Statement of conflict of interest

The authors declare no conflict of interest.

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