Determination of Protein content in Cheese Products

Q A Mukhiddinov¹*, D K Alimova¹, J E Safarov¹, Sh A Sultanova¹, A Aït-Kaddour²

¹Tashkent State Technical University, University str. 2, Tashkent, Uzbekistan
²Université Clermont-Auvergent, INRAE, VetAgro Sup, UMRF, 63370 Lempdes, France

Email: m_qobil@yahoo.com

Abstract: The high concentration of essential amino acids in cheese contributes to the growth and development of the human body. Despite the presence of a notable amount of saturated and trans-fatty acids, there is no clear evidence relating the consumption of cheese to any disease. The high concentration of calcium in cheese is well known to contribute to the formation and maintenance of strong bones and teeth, but also shows a positive effect on blood pressure and helps in losing weight in combination with low-energy diets. The SMART 6 is a system for rapid moisture and fat determination - in less than 5 minutes. The SMART 6 Moisture and Solids Analyzer uses dual-frequency microwave radiation to quickly analyze any product, wet or dry, in 3 minutes or less. Sprint® is a direct protein measurement system using biochemical protein labeling technology that only binds protein nitrogen. Measurement of total nitrogen can lead to erroneous results when non-protein nitrogen is present. Sprint does not require regular calibration and is easy to operate. Competitive express technologies require constant, costly calibrations and method development for each unique sample due to differences in color, texture and consistency.

1. Introduction
Food safety is of paramount importance to the dairy sector, which includes the overall quality of milk (as a primary product) and the quality of secondary dairy products produced from milk, such as cheese. Healthy cows' milk contains relatively few bacteria (102–103 cfu.ml⁻¹); however, milk remains a nutrient-dense natural food that can be contaminated easily post-milking [1]. For the time being, around the world cheese is demanded by a large portion of the total consumers for their dairy products because of its nutritional composition, in every particular, proteins, fat, mineral (e.g., calcium and phosphorus), flavor, and vitamins. This requirement is associated not only with high nutritional values but also with their health-promoting constituents that consequently reduce the risk of several diseases. Milk and dairy products are one of the potential categories of resources for providing functional food products, due to their content in a variety of essential components [2]. Cheese also provides high-quality protein, as well as phosphorus, vitamin A and zinc, which we need to help stay healthy. Although many kinds of cheese exhibit sensorial and technological properties that lend themselves to direct use as an ingredient (e.g., Emmental, Comt_e), specific manufacturing has emerged recently for the same application. It is likely that in the future, cheese manufacturing will evolve to meet specific ingredient uses [3]. There are different types of cheese that contains a little amount of protein. For example, a one-ounce serving of blue cheese contains 6 grams of protein. Blue
cheese is a great source of protein. Researchers also believe that the fat in certain dairy products, such as blue cheese, may have a neutral or even positive effect on cardiovascular health. Considering that blue cheese is a complex and anisotropic matrix due to the use of Penicillium, huge differences in the physicochemical properties have been observed suggesting that the use of the above-mentioned techniques that allow acquiring spectra on a small part of the sample is a little bit restricting and could limit the ability of classical spectroscopic techniques to authenticate cheeses and to predict efficiently some of their physicochemical parameters. Nowadays, multispectral and hyperspectral image analyses are becoming more and more attractive tools in research activities and for online monitoring of food processing [4-6]. However, Caprino is an Italian cheese traditionally made from whole or skim goat’s milk. Goat’s cheese is a hard mature cheese made from pasteurized milk. Caprino is a term encompassing at least 33 different goat’s milk cheeses produced of 3.50 fat and 3.06 protein. Protein is an essential nutrient our body needs to take in every day to work properly and is found throughout our body. Protein helps rebuild, maintain and repair body tissues, such as muscle and nervous tissue. Our body also uses it to make new cells and to create specialized proteins, such as hemoglobin, which helps carry oxygen to our body and support a healthy immune system. Some experts suggest that we may benefit from eating approximately 20-30 grams of protein at each meal to help achieve a higher protein diet [7-10].

2. Materials and methods

There are some kinds of cheese which are produced in Uzbekistan. For example, white cow’s cheese belongs to the group of cheeses that are matured and stored in a salty place. It is made from pasteurized sheep or cow’s milk. According to GOST, the cheese should contain 40-50% fat in the dry state, 4-8% salt, and 49-52% moisture. It is made using a milk enzyme. After pressing and shaping, the cheese is dunked into salt water (20-22% concentrate).

The White cheese should meet the following requirements: tasty and aromatic, sour, moderately salty, non-comminuted, with a slight porosity. Each piece of white cheese must weigh 0.6-1.5 kg.

Below is a description of how to make white cow’s cheese in Uzbekistan.

Mix dried rennet (2 g per 100 liters of milk) with an equal amount of table salt and dissolve the mixture in 0.3 liters of boiling water and cool down to 30°C. Prepare a mixture of pure and skimmed milk to make the dry cow’s cheese. Pour the mixture into a bowl and pasteurize at 65°C for 20 minutes, then cool to 32-34°C degrees and pour into a saucepan. Take a medium sample of the mixture to determine its acidity, density, fat content, and dry matter content (by calculation). Add a 40% calcium chloride solution (10-15 g per 100 liters of mixture) to the mixture. Determine the hardness of the syrup mixture to obtain the standard hardness. To do this, add 10 ml of syrup to 100 ml of milk with a pipette and mix quickly. The time from the addition of the solution to hardness indicates the strength of the syrup solution (in minutes). Determine the necessity of treating the syrup solution using the following formula.

\[ R = M \times 0.1/(V \times 60) \]

Here R- the amount of rennet: liter; M-amount of mixture, liter; K-Hardness of rennet, sec; V-specified hardness time, minutes.

Add the required amount of mortar to the mixture, stir and allow standing. Determine the degree of readiness of the alloy by tilting the alloy to the side, dropping it with a spatula, and holding it lightly. The finished alloy is tested without leaving splinters on the spatula. Place the polished and cooled foil on the table with the edges exposed. Place a container of liquid under the tabletop. Spread the curd mixture 2-3 cm thick on the foil in the bowl. Cut the alloy lengthwise and crosswise so that the whey separates more quickly. Tie the ends of the foil together and keep for 8-10 minutes. Peel off the foil and cut the mixture a second time. Press twice at 0.5kg per 1kg and 2kg per 1kg for 10-15 minutes. Cut the mixture into 10-15 cm wide and 7-10 cm thick plates, cool them with cold water, and place them in a saturated salt solution (20-22%). After a day, rub the boards with salt on all sides, put the plaster in wooden boxes, and pour the unsalted plaster on top. Determine the quality of the cheese.
after 5-6 days of cooking. As it is already mentioned, cheese is an important source of proteins and amino acids. It is well known that cheese provides all essential amino acids except methionine and cysteine in more than the recommended quantities for children or adults. Not only the proteins and amino acids play an important role in human nutrition; during the last 30 years, an intermediate product of proteolysis of proteins into amino acids has moved to the center of interest – bioactive peptides. These are special amino acid sequences within the proteins. As long as they are bound in the proteins they are biologically inactive. A wide range of biological activities has been described, including opioid, blood pressure-lowering, mineral binding, antimicrobial, immunomodulating, cell-modulating, anti-carcinogenic, anti-cariogenic, anti-thrombotic, anti-inflammatory, and cholesterol-lowering activities.

Two types of equipment were used to determine the moisture, fat, and protein content of the cheese. One of them is the SMART 6 which is an apparatus that can measure quick fat and moisture determination with results during 5 minutes. Further, Sprint’s direct protein measurement system employs dye-binding technology to guarantee that only true protein is detected, instead of total nitrogen, which could lead to erroneous measurements due to the presence of non-protein nitrogen. Sprint eliminates the need for regular calibrations, and methods can be easily formulated by any lab user. Competitive, faster technologies mandate progressive, high-cost calibrations and method development for every distinctive sample due to differences in consistency, texture, and color. This article shows that results for protein, fat, and moisture analysis performed using rapid testing technology are on par with the reference chemistry [4]. These technologies require only a very few preprogrammed methods to provide highly precise and accurate results within a few minutes when compared to competitive rapid technologies and reference chemistry. Four different samples of natural and processed cheese were commercially acquired and assessed for protein, fat, and moisture to exhibit the performance of rapid testing technology. For the analysis of fat and moisture, a 100 g sample of each type of cheese was pre-dried in the SMART 6 and determining fat and moisture [4].

The natural cow’s cheese method was used for measuring the natural Tillo Domor (piquant), Samarkand (with a taste of baked milk), Akula and Khorezm cow cheese types in Figure 1. These cow’s cheeses are produced in different regions of Uzbekistan.
For the analysis of protein, a 50 g sample was placed in the Sprint system to be automatically homogenized and evaluated through absorption at 480 nm. Four representative samples (low, medium, and high protein content) of known concentration were measured in four copies to form a response curve for creating Sprint methods. Once these methods are developed, they do not need recalibration [4].

3. Results and discussion
In the table below the precision and accuracy of rapid testing technology for the quantification of protein, fat, and moisture in cow’s cheese samples [4]. Another main component of cheese is fat. It varies between 20 and 35% of the dry mass. One portion (50 g) of full-fat cheese provides about two-thirds of the recommended daily intake of fat. Milk fat, and therefore also cheese fat except in mold cheese.

According to the results of the experiment, it is clear from the table below that the moisture content of Akula cow’s cheese is 40.55% higher than the rest, and the fat content is lower than all the others and the protein content is superior to the rest 46.59% and 25.41% respectively. The other three types of cow’s cheese have a lower moisture content than a shark, a higher fat content, and lower protein content.

Table 1. Experimental results of moisture, fat, protein of cow’s cheese are calculated by technologies as a percentage

| Indicators   | Samples, % |
|--------------|------------|
|              | Tillo Domor (piquant) | Samarkand (with a taste of baked milk) | Akula | Khorezm |
| Moisture     | 35.56      | 37.64        | 40.55  | 36.96   |
| Fat          | 57.74      | 47.42        | 46.59  | 63.34   |
| Total protein| 16.69      | 23.18        | 25.41  | 16.62   |
4. Conclusion

It is considered that the fat and moisture content of the cow’s cheese is accurately and quickly determined with the help of the SMART 6. The volume of protein in all the above samples is accurately determined by the Sprint system without the need for high temperatures or using hazardous chemicals. Research today is concentrated more and more on the influence of nutrition on human health. Calcium, which is present in large quantities in cheese, has been shown to have a positive effect on various disorders (hypertension, osteoporosis, obesity, and dental caries). However, these quick testing machines suggest a high level of exactness and reproducibility, maximum productivity and full automation, time-saving, moderate running costs results during a few minutes, that enabling better process control and, eventually, more savings than reference methods.

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