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Original Article

Bayes Modelling and Simulation for Milk Quality Testing

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Abstract - Milk is a nutrient-dense meal that is high in protein, which is essential for growth. Milk is an aqueous liquid composed of dissolved carbohydrates, protein aggregates and minerals, in which milk fat globules are suspended. As it is created to be a source of nutrition for a neonate, every component is advantageous to the developing child. Because it is a crucial component of our diet, and these adulterants have serious consequences on health. To overcome these issues, proposed a bayes modelling and simulation for milk quality testing. The main purpose of this work is to determine whether the Korean Milk Quality Index (KMQI) is real or fake by calculating the chemical and water content in the milk. Initially, preprocessing techniques provide a solution based on the milk quality index. Finally, the naive bayes algorithm calculates whether the milk contains water or chemical or is pure milk. The Naive Bayes algorithm accurately predicted milk, even in instances where data was absent. It is recommended as a dependable instrument for converting conventional and digital milk management.

Keywords - Korean Milk Quality Index, Milk quality index, Somatic Cell Count, Standard Plate Count, Preliminary Culture Count , Laboratory Pasteurized Count.

1. Introduction

Milk is a liquid, creamy food made by the mammary glands of animals. It is the primary source of nutrition for newborn animals until they can process a solid diet [1]. Milk defence is aided by immune proteins and immune-modulating components. It is high in vitamins and nutrients, especially calcium [2]. It is essential for bone wellness. Nutritionists advise people to consume milk and other dairy products, such as cream and cheese, on a daily basis as part of a healthy diet [3].

The most common tests used to determine milk quality are Somatic Cell Count (SCC), Standard Plate Count (SPC), Preliminary Culture Count (PIC), and Laboratory Pasteurized Count (LPC) Bacteria and E. coli [4]. SCC is a measurement of somatic cells and white blood cells in milk [5]. The nutritional value of milk makes testing and quality control an integral part of small, medium, and large dairy processing industries [6]. Since milk is 87% water, it is susceptible to adulteration by unscrupulous middlemen and dishonest farmers [7]. “Milk quality” is distinct as a set of qualities or characteristics that qualify a product [8]. These parameters can be quantified or modified to provide values that determine whether the evaluated milk meets the required standards. The quality parameter of milk can be related to its composition, hygiene, and hygiene [9]. Milk can cause many digestive problems, including bloating, gas, diarrhoea, and constipation. The main summary of the research's significant contributions:

- The main purpose of this work is to identify whether Korean milk is real or fake by calculating the chemical and water content of the milk.
- Preprocessing techniques provide a solution based on the milk quality index.
- Finally, the naive bayes algorithm calculates whether the milk contains water or chemical or it is pure milk.

The remaining study is structured as follows: Section 2 describes the literature review and is detailed. Section 3 describes the proposed method. Section 4 describes the testing of korea milk quality. Experimental results are given in section 5, and section 6 presents the conclusion.

2. Literature Survey

In 2020 Muñiz, R., et al. [10] suggested an innovative method for real-time measurement of individual cow milk samples in order to estimate necessary quality control metrics such as Solids-Non-Fat (SNF), lactose, protein, and fat concentrations in traditional cow milk. The model was created with Google Inc.'s commonly used machine learning platform TensorFlow.

In 2021 Hmoud Al-Adhaileh, M. and Waselallah Alsaade, F., [11] created an Adaptive Neurofuzzy Inference System (ANFIS) technique to predict the Water Quality Indicator. (WQI). Furthermore, in the test phase, the ANFIS model predicted WQI with 96.17% accuracy of the regression coefficients, while the FFNN model predicted WQC with 100% accuracy.

In 2022 Karaman, S., et al. [12] suggested a predictor of baked milk tolerance, especially milk intake, in the first Oral Food Challenge (OFC) trial in children with IgE-mediated milk allergy. A child with a cow's milk allergy can handle more than 620 milligrams of milk protein in a single test of unheated milk that can handle cooked milk. This implies that the child will be able to handle milk in the future.

In 2022 Golmohamadi, H., [13] suggested a methodical strategy for analysing various factors that influence atmospheric precipitation. Based on a four-year collection (2012-2015), an experimental assessment reveals a true detection rate of 80.4%, a false alert rate of 20.3%, and a total accuracy of 79.6%. In comparison to the available literature, our approach greatly reduces the rate of false alarms.

In 2023 Thompson, J., et al. [14] proposed MALDI-TOF mass spectrometry as a diagnostic tool to screen non-culture raw milk samples collected from local dairy farms for mastitis. The random forest model also works well, obtaining $J > 0.63$ with sens = 0.83 and spc = 0.81. Naive Bayesian models, generalised linear models, fast large amplitude models, and deep learning models did not produce such positive diagnostic results.

In 2023 et al. [15] suggested a novel wavelength interval selection technique known as the Synergy Interval PLS pair with the Monte Carlo approach. (MC-siPLS). Under typical nutrient circumstances, irrigation was done with Cadmium Chloride ($CdCl_2$) at amounts of 0, 0.05, 0.1, 0.2, 0.5, 1, 2, 5 and 10 mg/L. The outcomes demonstrate that MC-siPLS works better than related frequency spacing selection techniques.

3. Proposed Methodology

This section proposed a novel bayes modeling and simulation for milk quality testing for overcoming adulteration milk in Korea. The main purpose of this work is to identify whether Korean milk is real or fake by calculating the chemical and water content in the milk. Preprocessing techniques provide a solution based on the milk quality index. Finally, the naive bayes algorithm calculates whether the milk contains water or chemical or is pure milk. Figure 1 illustrates the overall flow diagram of the proposed method.

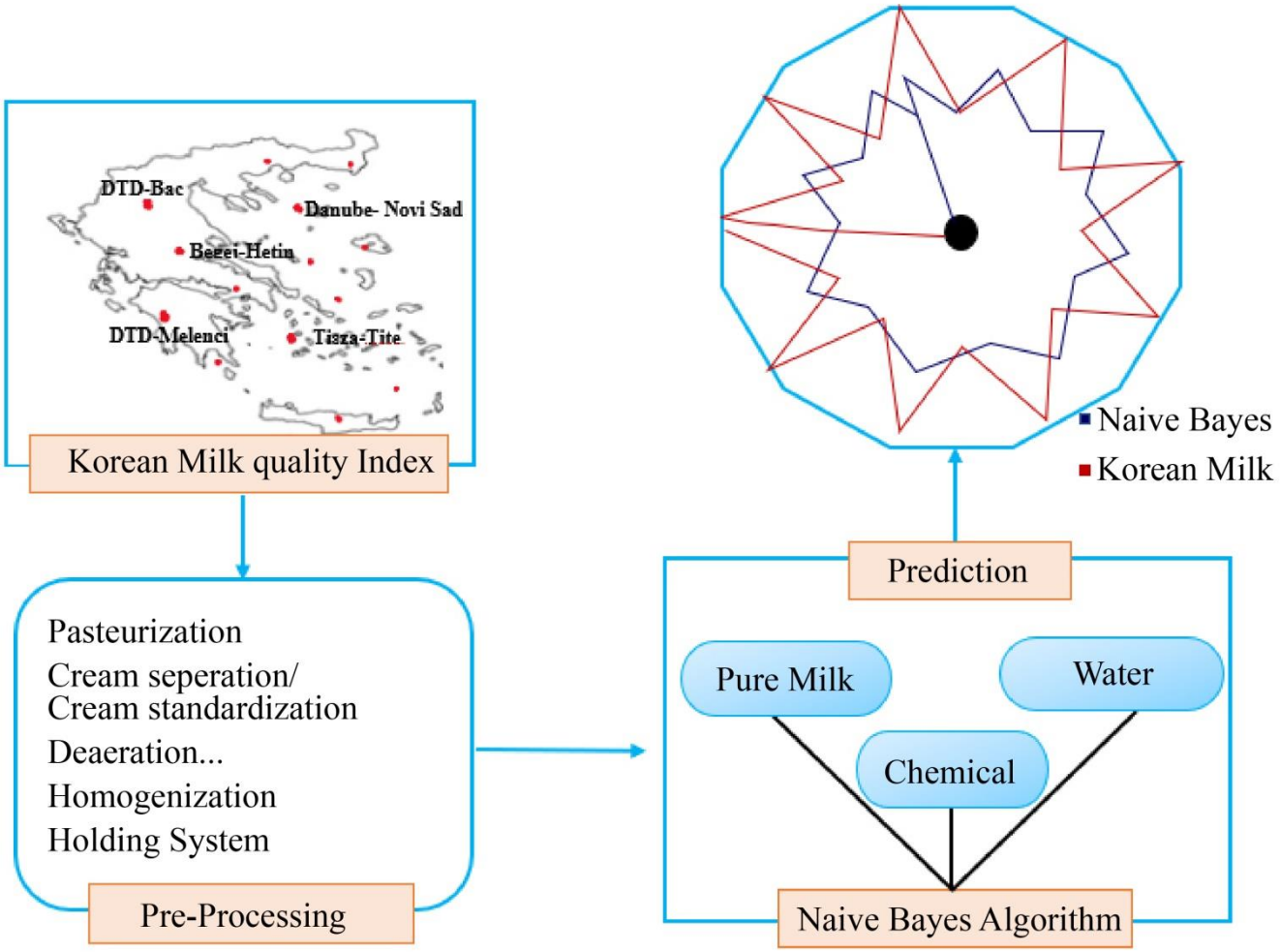


Fig. 1 Overall flow diagram of the proposed method

4. Korea Milk Quality Index

The quality required for Korean milk varies depending on the application, and suitability must be evaluated for each application. Milk quality assessment and control involve sampling, collecting, and analysing various milk quality parameters. Although many milk quality tools, methods, and classifications have been proposed, one commonly utilised method to assess ambient milk quality is the Korean Milk Quality Index (KMQI).

4.1. Preprocessing

In the milk preprocessing technique, pasteurization is a common and mandatory step in manufacturing all dairy products. Milk is pasteurised by heat treatment between 72-90 °C, depending on the type of product to be manufactured. The separation of milk fat from milk composition is an important issue in milk technology. Because milk fat is an expensive material, it is used as a raw material source in butter technology and has a wide range of applications in the food industry. As is well known, milk contains some air. Freshly expressed milk contains about 6% air by volume. However, the amount of air in the milk increases continuously during milking. The increase in the amount of air in the milk continues during processing and transportation after milking. The mixture formed as a result of the agitation of two non-mixing liquids is called an emulsion. In dairy production, a holding system is used to increase pasteurisation efficiency and to provide denaturation of serum proteins. The holding process is the process of keeping milk at pasteurisation temperature for a specified period of time.

4.2. Test for Adulteration in Milk

Here we discussed about test adulteration in milk. Figure 2 illstrates the test adulteration in milk.

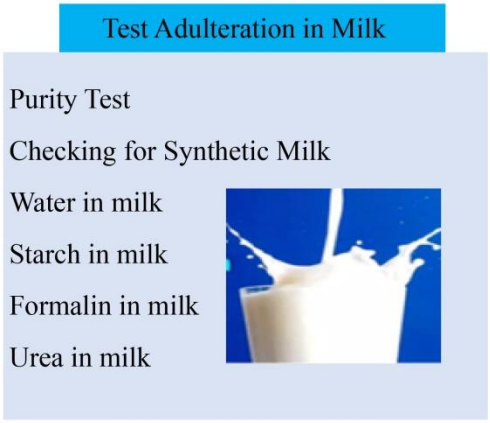


Fig. 2 Test adulteration in milk

4.2.1. Purity Test

Simmer over low heat for 2–3 hours until the milk is curdled and squirts. A rock-hard, coarse remnant indicates that the milk is tainted, whereas a viscous residue indicates that the milk is of high quality.

4.2.2. Checking for Synthetic Milk

Synthetic milk is combined with pesticides, detergents, and other additives to create synthetic milk. Only the unpleasant flavour of synthetic milk makes it identifiable. It takes on a golden hue when heated and rubs with a detergent sensation.

4.2.3. Water in Milk

Even if it hurts your pocketbook, the water in milk might not be bad for your health. Pour a drop of milk onto your foot or a sloped surface, and let it flow to verify. Milk is not clear if it leaves traces.

4.2.4. Starch in Milk

By mixing 2 teaspoons of salt (iodine) with 5 ml of milk, you can determine whether your seller has added starch to your milk. The combination will turn blue if the milk is tainted.

4.2.5. Formalin in Milk

Formalin is used for preservation purposes. It is used by packaging manufacturers for adulteration purposes due to its clear colour and long-term preservation of milk. Add 2-3 droplets of sulfuric acid to 10 ml of milk in a test container to check for the presence of formalin. If the milk has a blue rim on top, it is tainted.

4.2.6. Urea in Milk

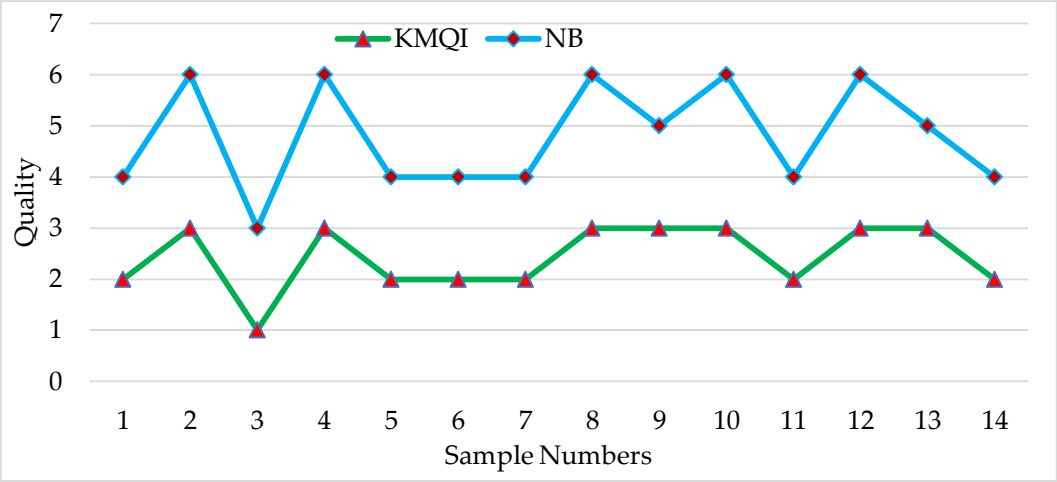
Urea is one of the most typical ingredients used to adulterate milk. This is so that it won't change the flavour and won't be easily noticed. Combine 1/2 spoonful of milk with kinako powder and shake well to check for urea in the milk. When the milk is dipped in the litmus paper for 30 seconds after 5 minutes, the colour will change from red to blue, showing the presence of urea.

4.2.7. Naïve Bayes Algorithm

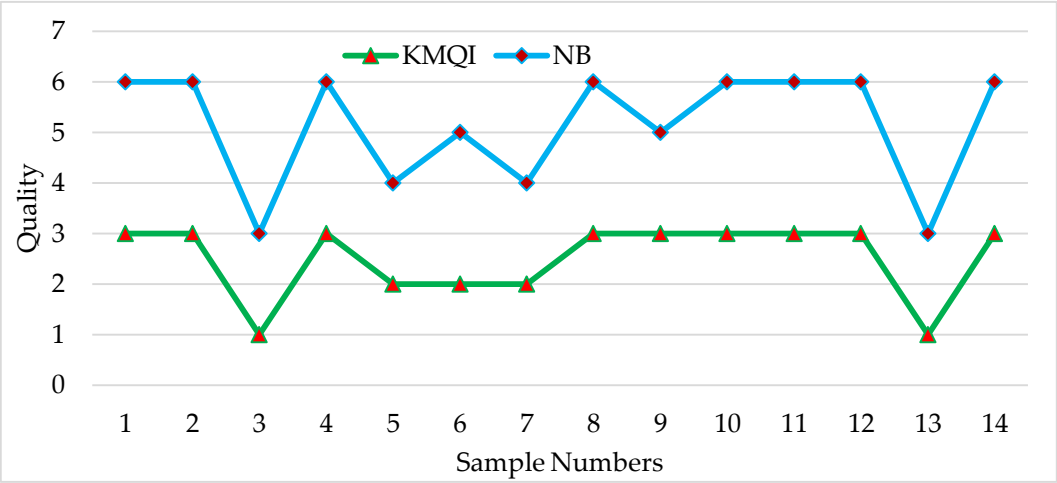
Naive Bayes is a straightforward learning method that relies on Bayes' law under the firm presumption that a class's characteristics are conditionally independent. Naive Bayes frequently offers classification precision that is competitive despite the fact that this independence premise is frequently broken in practice.

5. Result

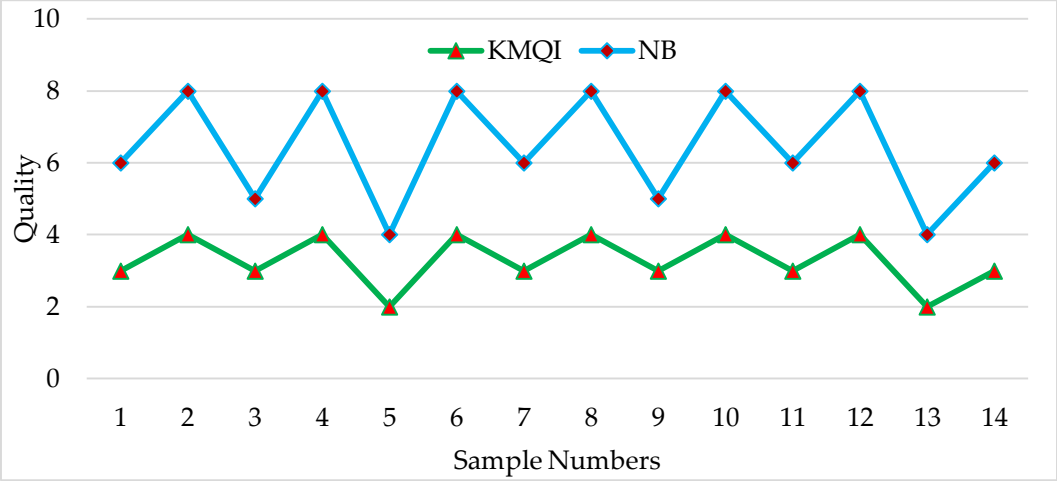
The experimental arrangement of the proposed technique identified them Korean milk is real or fake. The proposal was implemented using MATLAB to identify the best Resources and Scheduling. A graphical representation of the variances between assessed and predicted classes is depicted in Figures 3(a), (b), (c), (d), and (e).



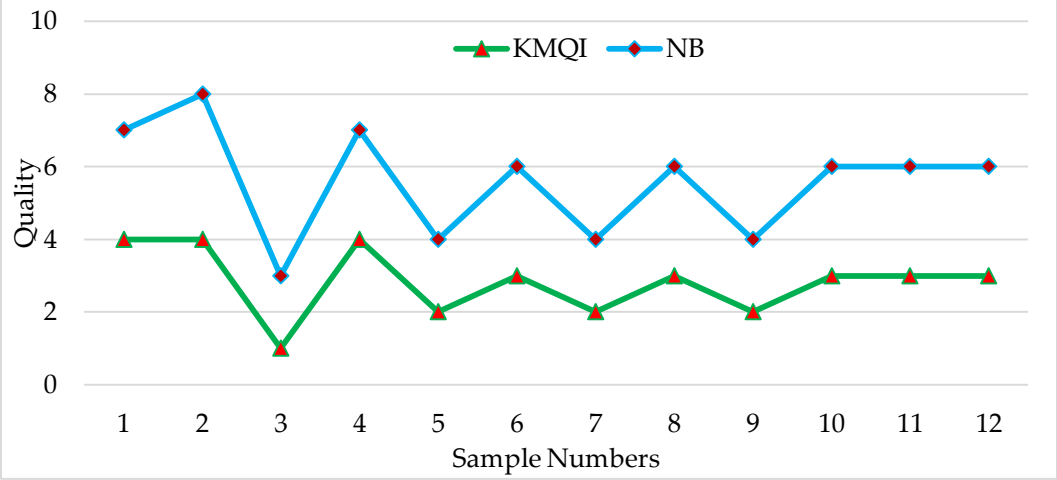
(a) Danube



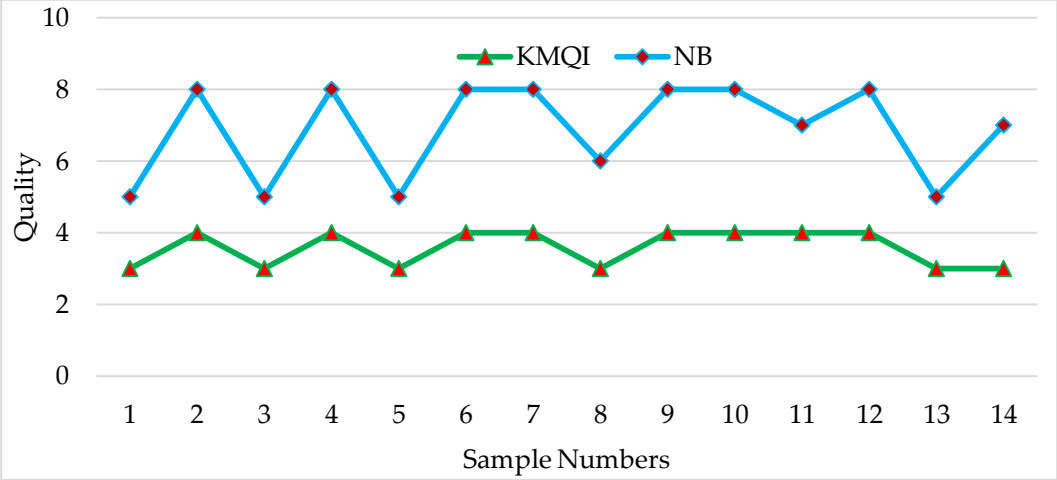
(b) Tisza



(c) Begej



(d) Melenci



(e) Bac

Fig. 3 (a), (b), (c), (d), (e) Shows the predicted milk quality

A graphical representation of the difference between the assessed and predicted classes is depicted in Figure 3. The sample numbers from 1 to 14 denote the quality of Danube milk: 15–28 Tisza, 29–42 Begezi, 43–54 Merenchi, and finally, 43–68 BC. The ordinal no. of the milk sample and the number of the milk quality index are entered on the abscissa.

6. Conclusion

This paper proposed a Bayes modelling and simulation for milk quality testing for identified the Korean milk is real or fake by calculating the chemical and water content in the milk. Initially, Preprocessing techniques provide a solution based on the milk quality index. Finally, the naive bayes algorithm calculates whether the milk contains water or chemical or is pure milk. The usual farm size for a dairy farmer in the future will be 50 to 100 animals or more, with a concentration on high-quality feed and silage, high-productive cattle, and mechanisation and automation for increased efficiency and profitability.

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