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Relationship between mozzarella yield and milk composition, processing factors, and recovery of whey constituents

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ABSTRACT

Our aim was to identify the relationship between mozzarella cheese yield and buffalo milk composition, processing factors, and recovery of whey constituents. A production of 30 batches of mozzarella cheese at a dairy industry in northeast Brazil (Rio Grande do Norte) was monitored between March and November, 2015. Mozzarella yield and 32 other variables were observed for each batch, and divided into 3 groups: milk composition variables (12); variables involved in the cheesemaking process (14); and variables for recovery of whey constituents (6). Data were analyzed using descriptive statistics, Pearson correlation, and principal component analysis. Most of the correlations between milk composition variables and between the variables of the manufacturing processes were not significant. Significant correlations were mostly observed between variables for recovery of whey constituents. Yield only showed significant correlation with time elapsed between curd cuttings and age of the starter culture, and it showed greater association with age of the starter culture, time elapsed between curd cuttings, and during stretching, as well as with milk pH and density. Thus, processing factors and milk characteristics are closely related to dairy efficiency in mozzarella manufacturing.

Key words: *Bubalus bubalis*, dairy product, efficiency, industry, cheese

INTRODUCTION

Mozzarella cheese is a typical product from Italy; however, its manufacture is relatively recent in Brazil, where a similar process to the Italian method is used, necessarily using whole buffalo milk (Brazilian Associa-

tion of Buffalo Breeders, 2014). Mozzarella cheese has an already established niche market with a promising future in Brazil due to the possibility of adding greater value compared with cheese made with cow milk. Thus, the number of industries that use buffalo milk in the manufacturing of their products is growing, with mozzarella cheese being foremost among these products (Brazilian Association of Buffalo Breeders, 2014; Tonhati et al., 2011).

In the manufacturing of dairy products, yield can indicate productive success in practical terms and is a valuable tool for improving the process and cost-benefit balance of the company. Solids concentration in buffalo milk, being mostly fat, protein or casein, and minerals, enables efficient production and quality of various derivatives to be higher than bovine milk (Rangel et al., 2011; Tonhati et al., 2011; Cipolat-Gotet et al., 2015). Italian industry is able to achieve about 20 to 22 kg of mozzarella from processing 100 L of buffalo milk, a yield almost 50% higher than bovine milk (Citro, 2010).

Several factors have an effect on the yield of dairy products, mainly those related to the technological quality of milk. These are directly related to the animals (i.e., genetics, nutrition, physiological, and health status) or the handling of raw materials (i.e., hygiene conditions, techniques used, and so on; Abd El-Gawad and Ahmed, 2011; Cipolat-Gotet et al., 2015; Sales et al., 2016). Especially for stretched-curd cheeses, yield mainly varies depending on the processing technology (stretching time), the raw material (industrial or natural yeast), and on the characteristics of the finished products (Citro, 2010).

The expression of cheese yield is important in 2 main applications: for economic manufacturing control and to express experimental results of the industry (Furtado, 2005; Abd El-Gawad and Ahmed, 2011). Therefore, this enables comparing the effective use of milk in various production processes, livestock, and animal species. Cheesemaking efficiency can be obtained by calculating the actual yield (Furtado, 2005) or its prediction

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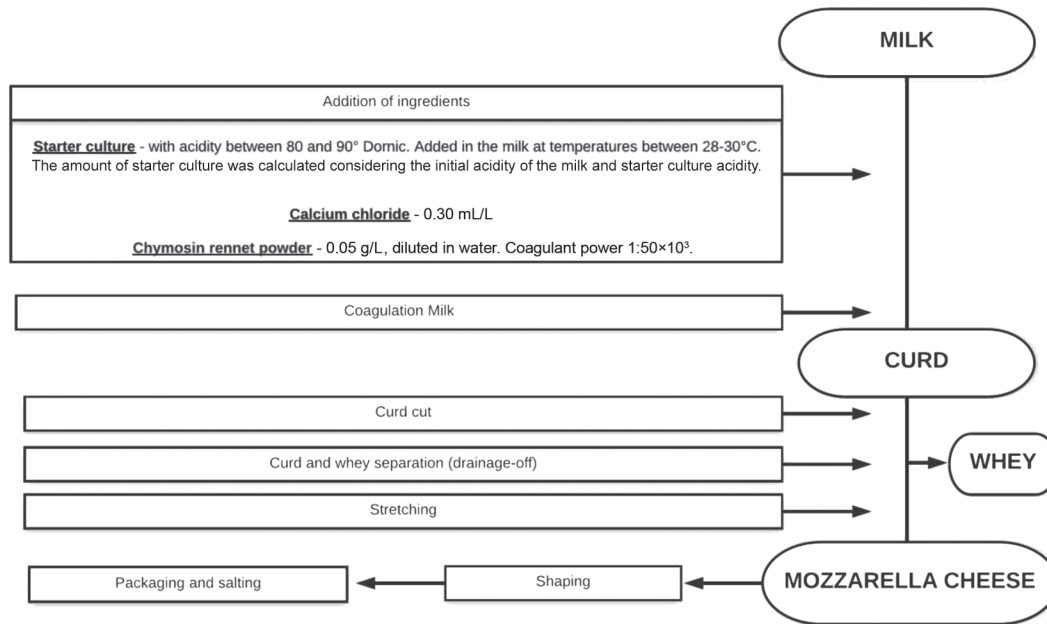


Figure 1. Steps of mozzarella cheese manufacturing technology.

before production, often being used for the payment of milk quality, and also for production estimates (Abd El-Gawad and Ahmed, 2011; Sales et al., 2016).

Knowledge regarding the relationship between mozzarella cheese yield and productive aspects can provide complementary calculation methods of manufacturing efficiency to the already existing methods and also allow greater understanding about the milk technology and its use, specifically based on information regarding mozzarella cheese. In this sense, the present study aimed to identify the relationship between mozzarella cheese yield and variables of milk composition, processing and the recovery of whey constituents.

MATERIALS AND METHODS

Data Collection

The study was conducted in a dairy plant located in Taipu, Rio Grande do Norte, Brazil. The industry has certifications from the Federal Inspection Service and from the Brazilian Association of Buffalo Breeders (100% buffalo purity label), and also has a trademark for mozzarella cheese and other products made from buffalo milk. Processing of 30 lots of mozzarella cheese was monitored weekly from April to November 2015, respecting the industry schedule. The average number of days between monitoring the production lots was 7.45 ± 2.69 d. The milk used for manufacturing the cheese was produced by the herd from the dairy plant,

containing an average of 350 lactating buffaloes. The animals were grazed in pasture under Voisin-type rotational stocking, with the predominant pastures being *Brachiaria brizantha* and *Panicum maximum* L. Massai. Buffaloes were mechanically milked twice a day (morning and afternoon), without the presence of calves, with the adoption of all the procedures of good milking practices, such as the use of pre- and postdipping. The milking equipment was a double-20, single line type, with a low line in closed circuit.

Mozzarella Cheese Manufacture

Mozzarella was produced by enzymatic coagulation of milk following the recommendations from Citro (2010), to obtain a cheese very close in characteristics to the same Italian cheese. The employed manufacturing technology in mozzarella cheese production consisted in the steps of Figure 1.

Sample Collection

A sample of raw milk was collected from the milk arrival flow at the receiving tank for each of the 30 lots monitored within the dairy plant, and a whey sample from mozzarella cheese at the end of drainage off the curd was collected directly from the production tank. They were identified, placed in plastic vials of 40 mL, and maintained at a temperature between 4 and 7°C until analysis.

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