

Importance of Sodium Nitrate in the Maturation Process of Gouda Cheese

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Abstract. The aim of this study was to observe the dynamics of sodium nitrate during ripening, in was introduced in different amounts in the recipe. Sodium nitrate is the chemical compound also known as Chile saltpeter or Peru saltpeter, is used as an ingredient as a food preservative. Sodium nitrate should not be confused with the related compound, sodium nitrite. Sodium nitrate in the cheese gives a longer time of preservation (Moore J.C., 2010).

Keywords: sodium nitrate, maturation, Gouda cheese.

INTRODUCTION

Chile mined the largest deposit of sodium nitrate, sometimes called Chile saltpeter, until recently. Although it occurs naturally, now chemical companies provide synthetic forms to food processors and fertilizer companies. Because sodium nitrate may form suspected carcinogens called nitrosamines during digestion, there may be some dangers associated with excessive consumption or inhalation of the dust. However, sodium nitrate has many beneficial uses. Butyric bacteria in milk forms an acid during cheese fermentation that destroys the flavor and texture of the cheese.

Pasteurizing the cheese milk destroys the growing (vegetative) *C. tyrobutyricum* bacteria. However, the resting (dormant) cells, also known as spores, are not exterminated. Ultimately, the spores can germinate in the cheese into vegetative cells and subsequently form CO₂ and butyric acid. During this butyric acid fermentation, cracks appear in the cheese along with an aberrant and unwanted aroma. Brine and nitrite inhibit the germination of the butyric acid bacteria spores.

The salt absorbed by the cheese during the brine bath inhibits the germination of the spores. However, this salt absorption is a slow process and does not offer sufficient protection against butyric acid fermentation during the brine bath as well as during the early stages of ripening. Adding Sodium nitrate halts the butyric acid fermentation process. Sodium nitrate is converted into nitrite by the enzyme xanthine - oxydase and the nitrite stops the germination of butyric acid spores. The nitrite is slowly reduced in the cheese

In the technological process of Gouda Cheese fabrication sodium nitrate is used as curing agent. As it is considered a potential cancer E substance, this paper shall present the elimination effect of this substance from the technological process, analyzing the obtained results.

MATERIALS AND METHODS

The defining of yeast and moulds – the usage of Petrifilms.

Petrifilm plate methods are advanced cultural techniques as an alternative to standard plate count methods for microbiological food testing. The methodology for plating on Petrifilm plates is quite simple and the steps to be followed in each product are identical. As far as economic aspect is concerned, and compared to the traditional plate count techniques, Petrifilm plate methods can be considered to have an advantage as a greater number of samples can be processed, thus increasing the work capacity of the laboratory and reducing labour costs per sample or test. Using these modern systems for assessing microbiological quality of food ensure the application of suitable corrective measures in the manufacturing process and prevents the food product from being marketed before the quality control results have been received. (Bahrim Gabriela, 2003).

The defining of total nitrate – method of cadmium reduction column and spectrometry (EN ISO 14673-1:2004).

A quantitative colorimetric method for the determination of nitrate and nitrite in cheese has been subjected to collaborative study. The method includes clarification of an aqueous extract of cheese with zinc hydroxide, reduction of nitrate to nitrite via a spongy cadmium column (the nitrite originally present is unaltered), diazotization of sulfanilic acid with the nitrite, and coupling with 1-naphthylamine hydrochloride to form a pink azo dye whose absorbance is measured at 522 nm. The spectrophotometric responses are compared to a standard curve. In samples containing both nitrate and nitrite, nitrate is determined by difference. A standard deviation of 5.5 was obtained (5 of 6 collaborators) when a cheese sample spiked with 276 ppm sodium nitrate was analyzed by the method. The method has been adopted as official first action.

Physical chemical analysis of cheese was made with FoodScan™ Dairy Analyser.

FoodScan™ Dairy Analyser is a fast, accurate and easy to use instrument for analysing cheese. It accurately measures a variety of parameters including Fat, Protein, Moisture and Salt. It requires a minimum of sample preparation and delivers results in just 50 seconds. Near Infrared analysis is a spectroscopic technique, which makes use of the naturally occurring electromagnetic spectrum. The NIR region is the area of the spectrum defined by wavelengths as between 700nm and 2500nm. FoodScan™ Dairy Analyser works with Near Infrared Transmission in the region 850-1050 nm. An intuitive analysis flow and user friendly presentation of results helps to eliminate operator errors, and quickly identified out of specification results. Proven method and in compliance with Iso 21543 /IDF standard 201.

RESULTS AND DISCUSSION

The elimination of sodium nitrate from the technological process has brought about the reduction of the maturation and outage period of Gouda product. The production is somehow lowered but the product has to be delivered to the client earlier and the maturation of Old Gouda (long matured cheese, for approximately 12 months) it is almost impossible.

The Codex Standard 266-1966 established level for Gouda Cheese, concerning the maximum nitrate quantity in cheese is 0.035g/kg.

There have been used 3 batches of cheese, numbered as follows:

P1 – Processed cheese in which a quantity of 350 ml sodium nitrate have been added

P2 – Processed cheese in which a quantity of 175 ml sodium nitrate have been added

P1 – Processed cheese in which a quantity of sodium nitrate is 0 (null).

Analyses physical chemical were performed 3 weeks after production. There are 4 categories of Gouda cheese, Plain Gouda cheeses from Young (2-4 Months), Belegen (4-6 Months), Mature (6-9 Months) , and Aged (9-12 Months). In this study we refer to a young Gouda.

The resulted quantity of sodium nitrate, as a result of the maturation process is highlighted in the 1-st table, highlighting being done for each batch. We can notice that the differences are very close to the upper limit – for the standard processed batches, taking into consideration the following of the manufacturing standard.

Tab. 1

The sodium nitrate quantity resulted from the maturation process

Sample	Sodium nitrate quantity	Difference up to the maximum standard limit of 0.035g/kg is:
P1	0.034	0.001
P2	0.020	0.015
P3	0.009	0.026

After using these quantities of sodium nitrate in the manufacturing process, the three batches have had different maturation behavior, as referring to the physical chemical parameters this being presented in table no. 2, and to the microbiological load, this being presented in table no. 3.

Tab. 2

The physical chemical parameters of the Gouda cheese

Sample	Proteina %	Grasime / S.U g%	S.U. g%	Sare g%	pH
P1	15.42	49.8	57.2	1.81	5.20
P2	15.56	49.2	56.9	1.93	5.26
P3	16.56	48.5	55.9	1.94	5.39

From this table we can observe that, in case the nitrate quantity is big as in sample P1 the maturation is slower than in case of P3. Accelerated aging is not indicated because it produces a number of defects and increases the number of the microbiological load, this case being presented in table no. 3.

Tab. 3

The microbiological load of the Gouda cheese

Sample	C.P. Staphilococci ufc/cm2	Coliform Bacteria ufc/cm2	Yeast and Moulds ufc/cm2
P1	30	4	2
P2	52	8	7
P3	108	14	18

From this table we can observe that, in case the nitrate quantity is big, the microbiological development of bacteria is reduced, as seen in the P1 sample. The quantity of nitrate is 0.034 g/kg and the microbiological load is small. A comparison between the three batches can be observed in Fig. 1.

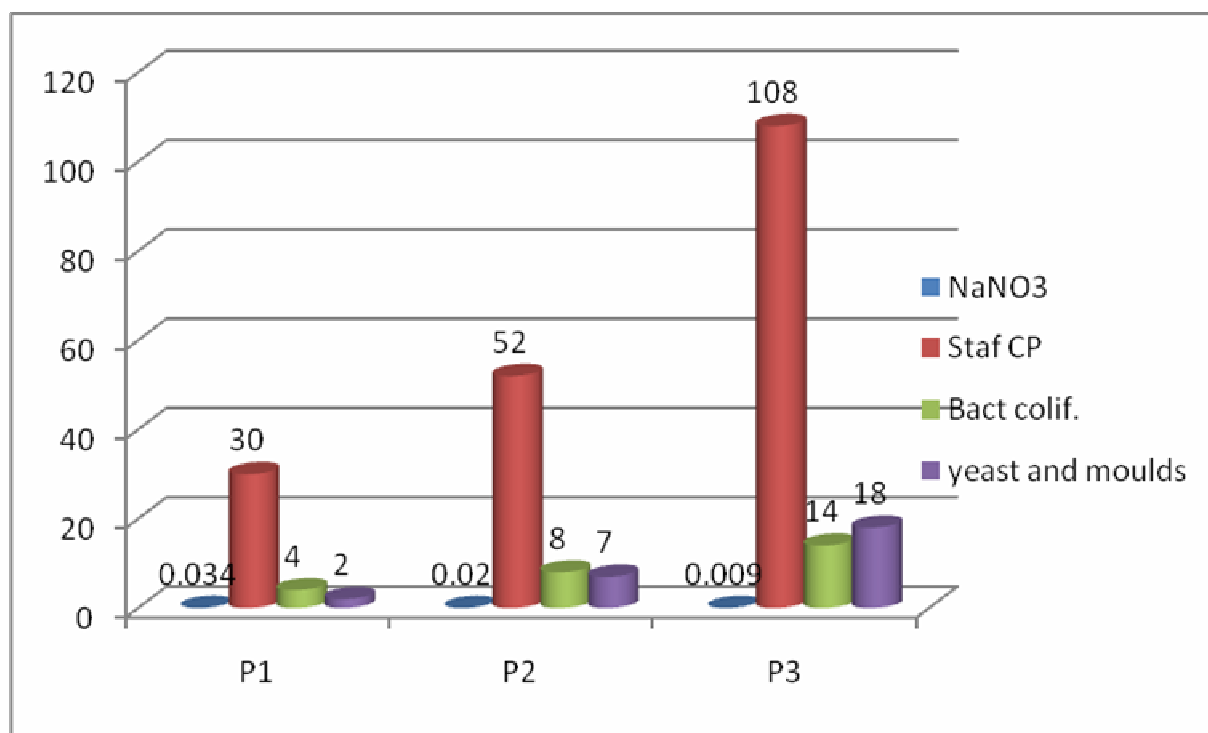


Fig. 1. The parameters evolution in the three batches

As the added nitrate quantity is lowering we can observe a growth of the coagulation-positive Staphylococci number, a possible cause of inhibitors absence, but, inspite of these,

the value is to be found in normal limits (max.1000 ufc/g), as to the EC Regulation no. 1441/2007. The same thing happening can be observed with the number of Coliform yeast and moulds, but these do not present an accelerated growth as that of the coagulation-positive *Staphylococci*.

CONCLUSIONS

The bigger the nitrate quantity, the smaller the microbiological parameters are and in these conditions, the validity of the product can be extended. Probably, the best variant would be the one marked out by P2, that is, the reduction of nitrate content to half, compared to the quantity used in present. NaNO_3 can be used as curing agent, but the legislation in power concerning these type of curing agents must be followed.

Accelerated aging is not indicated because it produce a number of defects and increase the number of the microbiological load, and the very short period of one month warranty .

The entry of pathogenic bacteria into the milk supply may occur at several stages along the production chain, raw milk contamination, mixing of contaminated milk with uncontaminated milk, post-pasteurisation contamination. The most important place where this may occur is at the farm level as the greatest number of organisms may be added at this point. During milking there are numerous places where milk may become contaminated with pathogens, through the milk in a sub-clinically infected cow, improper cleaning of the udder prior to milking, poorly cleaned milking equipment, or contamination from environmental sources. If not add sodium nitrate is not inhibited the development of bacteria.

In the present day conditions, the responsibility for a healthier life is everybody's responsibility, the producers who should produce more sane food, as well as the consumers who should orient themselves to products having less curing agents. Sodium nitrate forms nitrosamines, a human carcinogen, known to cause DNA damage and increased cellular degeneration. Studies have shown a link between increased levels of nitrates and increased deaths from certain diseases including Alzheimer's, diabetes mellitus and Parkinson's, possibly through the damaging effect of nitrosamines on DNA. (Monte S. *et al.* 2009).

Although some health concerns are present, without sodium nitrate it would be very difficult to transport cheese as it would spoil much quicker. A shorter shelf life in the grocery store means a shorter shelf life in our pantries.

Acknowledgment:“ Research conducted in the POSDRU/6/1.5/S/26 project financed from European Social Fund by Sectorial Operational Program Human Resources 2007 – 2013”.

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