”LUCIAN BLAGA” UNIVERSITY OF SIBIU
DEPARTMENT OF AGRICULTURAL SCIENCES, FOOD INDUSTRY AND ENVIRONMENT PROTECTION

Doctor’s Thesis

- ABSTRACT -

Research regarding the improvement of the manufacturing process of Gouda type cheeses

SCIENTIFIC COORDINATOR:

Prof. Univ. Dr. Ing. Ovidiu Tiţa

Ph.D. Student:

Noje Alexandra

Sibiu, 2011

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FOREWORD

"Scientific research represents the engine of the development of society, ensuring its progress and well-being. Scientific researsh is the provider of knowledge, the one that brings about the change that calls for the necessity of permanently ameliorating the performances and continuously creating new opportunities. Change means new things, it means the encrease of the level of knowledge, it determines the emergence of new values, it opens new horisons for cooperation and internationalization."

(Prof. univ. dr. ing. Constantin Oprean).

This doctor's thesis has been written as part of the POSDRU/6/1.5/S/26 project, financed by the European Social Fund with the title "Increasing the role of doctoral studies and doctoral competitiveness in a united Europe". The residency of the transnational mobility required by the doctoral research-preparing program included in the research project was done in Holland at "Scherjon Dairy Equipment Holland BV" for a period of five months.

The scientific research, the accomplishment of the concept and the development of this doctoral thesis would not have been possible without support from the people involved directly or indirectly, who have provided productive criticism and have appreciated the results.

I would like to use this opportunity to thank my scientific coordinator **Prof. univ. dr. ing. Ovidiu Tiţa** for her support, for sharing engineering experience and for his patience, all taken to the limit but still maintained inside the limits of professionalism during the entire period of my research activity. For good advice and experience in the field of engineering that helped me throughout the research, I would like to thank **Conf. univ. dr. ing. Mihaela – Adriana Tița**.

I would also like to express my gratitude and thanks to **ing. Hielke Scherjon**, executive director of "Scherjon Dairy Equipment Holland BV", Holland.

I would also like to express my gratitude and thanks to **ing. Piet Klaver**, executive director of "KlaverKaas", Holland.

I would also like to express my gratitude and thanks to **Viorel Ioniță,** administrator of "S.C. Gouda Gold S.R.L.", Romania.

To the faculty of the Department Of Agricultural Sciences, Food Industry And Environment Protection from Sibiu as well as to the members of the evaluation and examination commissions I would like to give my thanks for their recommendations regarding the increase in the quality of my research activity.

Thanks for the good cooperation of people of national and international public institutions that helped me with the analyzes in this thesis: DSVSA Brasov, DSVSA Baia – Mare, DSVSA Cluj – Napoca, DSVSA Sibiu, USAMVCJ, Dutch Food and Consumer Products Safety Authority.

I would like to thank my family and friends for their understanding, love and moral support during my research; they gave me the motivations and the necessary conditions for working on and finalizing my doctor's thesis.

Alexandra Noje

CONTENTS

INTRODUCTION

"A cheese may disappoint. It may be dull, it may be naive, it may be over sophisticated. Yet it remains, cheese, milk's leap toward immortality." Clifton Fadiman (American writer and editor; New Yorker book reviewer, 1904-1999).

Cheese is one of the most common foods, found everywhere around the world in the last years in variants that are more and more different from each other, some of them strange. The Latin word 'caseus' is the one from which the word 'cazeina' derives. 'Cazeina' is a proteic substance found in milk that, by curdling, forms the basis of cheese. 'Caseus' is also the root of the words that mean cheese in other languages: 'cheese' in English, 'kaas' in Dutch, 'Kase' in German, 'queijo' in Portuguese, 'queso' in Spanish.

Cheese is one of the most complex foods made from milk. Whether we discuss cheeses made from cow milk or the ones made from the milk of other mammals (sheep, buffalo cow, goat, or even reindeer or camel), cheese is a very good source of calcium and fats for the organism. Cheese is a food with a very high nutritional value due to the rich its protein, fats, minerals and vitamins content, a very good quality nutrients and a high bioavailability.

For all kinds of cheese there is a series of common nutritional traits that have to be taken into consideration in the general context of a diet and we have to mention cheese as being a nutritious and versatile that can play a very important role in a correct and balanced diet.

Cheese is a very varied and refined product that has spread in the entire world. It can have a very pleasant taste that can be buttery, rich, creamy, spicy, stinging, salty or light. Cheeses are products that enjoy a widespread 'popularity' due to their positive and healthy image, appreciated by the consumers as having positive effects on their health.

There are over 650 types of cheese in the entire world (according to Wikipedia) most of them being made from cow milk.

THE SCIENTIFIC OBJECTIVES OF THE THESIS

The opportunity of being a Ph. D. Candidate as part of a national research program has motivated me to achieve my results and to publish them in scientific papers that could contribute both quantitatively and qualitatively to the national and database and to the database of the "Lucian Blaga" University from Sibiu.

The main objective of this paper has been:

- **The modernization of the manufacturing process line to obtain Gouda type cheeses, that is modernization of the pre-press and of the storage and maturation.**

The secondary objectives were:

- Studying the present stage of Gouda type cheese processing and identifying the new modernization points;
- The application of the modernization measures to the technological flow and following the results (the improvement of the pre-press with the help of the agitator for the homogenous distribution of the spice in the cheese; the maturation in stages and separate of the cheese in 3 chain linked cold rooms, plank hygienisation machines in the maturation storehouses and automated slicing lines);
- Further studying the analysis and control methods developed and tested as part of the studies done: fat, protein, freezing point, dry substance, E. coli, positive coagulaso Staphylococci, yeasts and molds, flavors;
- Making a prototype of a pre-press with agitators and studying the results;
- Testing the new maturation and storage conditions, studying the results;

THE STRUCTURE OF THE THESIS

Bearing in mind the fact that the objective is to study the modernization of the manufacturing technological line to obtain Gouda type cheeses, that is: modernizing the pre-press and the storing and maturation conditions, the present paper presents in six chapters contributions and methods developed and used with the purpose of improving the Gouda type cheeses manufacturing technological line.

The first chapter of the paper presents the main and secondary scientific objectives of this study.

The second chapter of the paper presents the present state of the manufacturing technology. This chapter in fact presents the documentary study necessary to establish the theoretical premises that have generated the coordinates of the doctoral research. The theoretical basis of the Gouda type cheese manufacturing process are detailed, the necessary steps as well as the addition of lactose cultures, lysozyme, colors and the variables involved in the maturation process. This chapter ends with a study of the advantages and disadvantages of using this technology.

The third chapter of the thesis is represented by experimental studies and results obtained throughout the thesis. The research was done on four types of Gouda cheese: natural Gouda, Mustard and Pepper Gouda, Spicy Gouda and greens Gouda, that have been under the same technological process until the moment when they reach the pre-press.

This chapter is structured in four parts as follows:

- 3.3.1. Analysis of the raw milk;
- 3.3.2. Analysis of the raw cheese;
- 3.3.3. Analysis of the matured and maturing cheese;
- 3.3.4. Statistical analysis of the results.

In order to improve the technological flow and to make the Gouda type cheese manufacturing process more efficient we have introduced the following modifications:

- The modernization of the pre-press by adding two agitators;

In the present technological flow the homogenization in the pre-press is handled by two operators that mix the curdle mass. The homogenization of the curdle mass with the spices. When natural Gouda cheese is processed the whole mixing process takes place – correct homogenization, the cheese being beforehand matured and delivered in optimal conditions cu a minimum of loss, this happening only at the delivery by slicing – shaping and during maturation by loss of weight. Problems arise only when the spice cheese is processed. The curdle mass does not mix homogenously with the spice as it migrates either in the inferior part of the press (as in the case of mustard, pepper, tomatoes) or in the superior part, rising to the surface of the surface (as in the example of greens). Due to the irregular dispersal of the spices in the curdle mass the following happen:

- The maturation is not adequate: the fermentation of the spice, inadequate waxing, wheels with defects, the spice flavor is not uniformly spread through the cheese;
- the salting process is not adequate and it runs the risk of contaminating the brine bath with spice suspension;

- downgrading the cheese in the moment of delivery: there are 4 categories: **the premium category** (cheeses without any maturation and pressing defects, these cost 9€/kg), **the standard category** (cheeses with small maturation defects: irregular wax, spice not uniformly spread, these cost 6€/kg), **the B category** (cheeses with manufacturing and maturation defects that can be sold with a loss of 30-40% at shaping, these cost 4€/kg), **the C category** (chesses with major manufacturing defects and remains from shaping and incorrect maturation, these cost 2€/kg and are usually sent to the melted cheese processing factories).

The modernization of the pre-press consists of placing two agitators; this way mixing the curdle mass will be uniform and there will no longer be pressing defects (inhomogeneous mixing of the ingredients: garlic, mustard, parsley and other; cheese pieces with different sizes etc). this type of cheese is analyzed inside the pre-press to highlight the necessity of its modification. Samples have been taken to determine the homogeneity of the spice in the cheese and implicitly determining the pieces of premium cheese, as well as physicochemical determining after the cheese agitation process.

As in our case the spices are heavy they have the tendency to migrate to the lower side of the pre-press and manual homogenization is difficult to make, leading in many cases after pressing to maturation and slicing defects and most importantly to defects of a visual nature. If the spice has in its composition elements that have a lower weight than that of the curd beans they have a tendency to rise above the curd, but if they have a higher weight they have a tendency to migrate to lower part of the pressing valve.

A conclusion of this chapter to this processing version would be that the highest homogeneity of the agitator in all the three cases was at 64 rotations per minute (figures 1,2,3) , the number of cheese pieces with premium quality rising by more than half of the number of cheese pieces processed with the standard technology. The number of rotations influences the accumulation of water in the piece of cheese or its decrease and implicitly later maturation of the product; by studying their influence in the technological process, we chose the best rotation taking into consideration: the nature of the spice, the maturation parameters, the number of premium quality cheese. The installation of the agitator is efficient but not enough to obtain the maxim number of premium quality cheese.

The homogeneity in Mustard and Pepper Gouda is presented in figure number 1.

In this case we have a number of 48 pieces of cheese, a number of 31 pieces are premium the remaining 17 pieces having defects of uniformity which brings us to the view finder as we got to 64.58% product premium, the agitators are effective but apparently do not reach an efficiency of 100% in this case.

MUSTARD & PEPPER PRESSING WITH TWO STIRRERS (SN:01T3.3)				
nr./row / rows	1	2	3	4
1	45	46	47	48
2	41	42	43	44
3	37	38	39	40
4	33	34	35	36
5	29	30	31	32
6	25	26	27	28
7	21	22	23	24
8	17	18	19	20
9	13	14	15	16
10	9	10	11	12
11	5	6	7	8
12	1	2	3	4

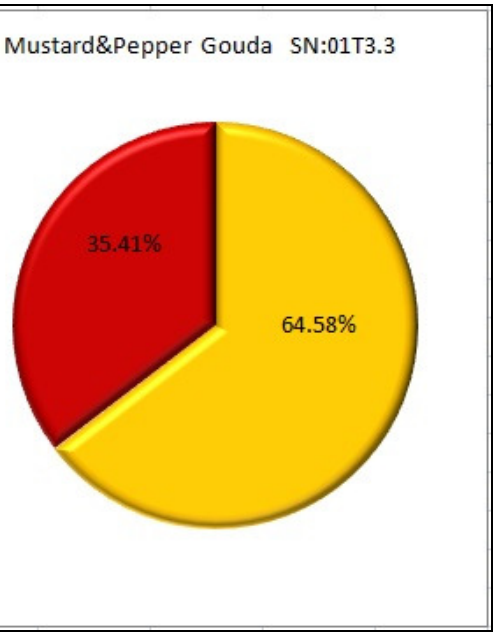

Figure 1. Mustard and Pepper Gouda SN:01T3.3 (personal archive)

The homogeneity in Spicy Gouda is presented in figure number 2.

In this case we have a number of 48 pieces of cheese, a number of 43 pieces are premium the remaining 5 pieces having defects of uniformity which brings us to the view finder as we got to 89.58% product premium, the agitators are effective but apparently do not reach an efficiency of 100% in this case.

SPICY GOUDA PRESSING WITH TWO STIRRES (SN:02T3.3)				
nr./row / rows	1	2	3	4
1	45	46	47	48
2	41	42	43	44
3	37	38	39	40
4	33	34	35	36
5	29	30	31	32
6	25	26	27	28
7	21	22	23	24
8	17	18	19	2
9	13	14	15	16
10	9	10	11	12
11	5	6	7	8
12	1	2	3	4

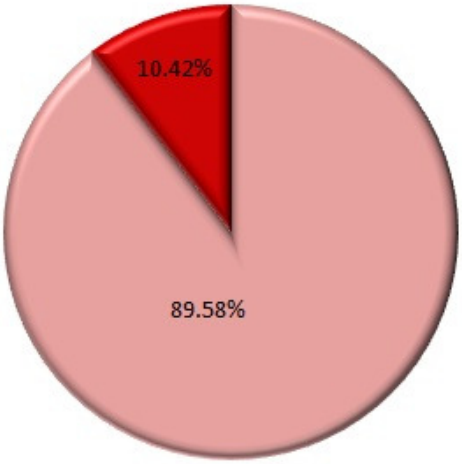

Figure 2. Spicy Gouda SN:02T3.3 (personal archive).

The homogeneity in Spicy Gouda is presented in figure number 2.

In this case we have a number of 48 pieces of cheese, a number of 41 pieces are premium the remaining 7 pieces having defects of uniformity which brings us to the view finder as we got to 85.42% product premium, the agitators are effective but apparently do not reach an efficiency of 100% in this case.

GREEN GOUDA PRESSING WITH TWO STIRRES (SN:03T3.3)				
nr./row / rows	1	2	3	4
1	45	46	47	48
2	41	42	43	44
3	37	38	39	40
4	33	34	35	36
5	29	30	31	32
6	25	26	27	28
7	21	22	23	24
8	17	18	19	20
9	13	14	15	16
10	9	10	11	12
11	5	6	7	8
12	1	2	3	4

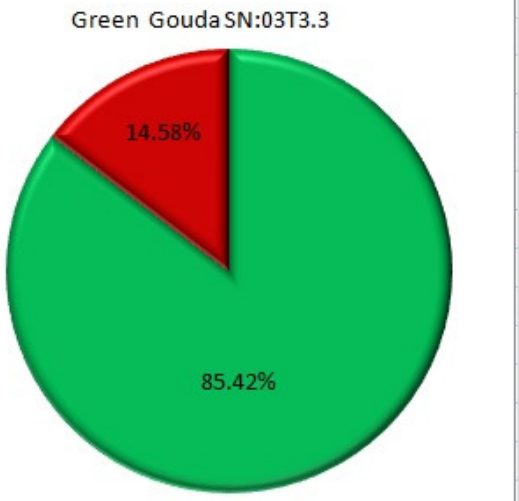

Figure 3. Green Gouda SN:03T3.3 (personal archive).

During the maturation process a stronger dehydration of the Natural Gouda cheese takes place, which leads to the an increase in the quantity of dried substance and implicitly of the salt content. Another conclusion of this chapter would be that the time Gouda cheese is kept in brine differs depending on the ingredients used, noticing that by using the spice pepper the salting time is longer than in the case of cheese where greens have been used. The Natural Gouda cheese present a higher content of salt than the other two assortments because the dehydration of the cheese during the maturation process is higher. The ingredients used in obtaining some assortments of Gouda cheese influence the salt concentration both during the salting process in the brine and during the maturation process.

- ❖ Modernizing the maturation system, transforming the one chamber system into a three chambers system.

Optimizing the maturation process, the acceleration of the maturation and delivery of the product that present the same characteristics a lot faster to the client (Brown J.A., (2002)). Avoiding uneven maturation. There are four categories of Gouda cheese beginning with Young Gouda (maturation period 2-4 months), Belegen Gouda (maturation period 4-6 months), Mature Gouda (maturation period 6-9 months), Old/Aged Gouda (maturation period 9-12 months). We are referring only to Young Gouda with the maturation period of 2-4 months. Optimizing the process makes the maturation period reduce by half.

The maturation difference between a traditional storehouse and a chambered one is also the small variation of the factors that influence the maturation process. These vary within small limits while in the traditional storehouse there are temperature and humidity variations up to 2-3°C and humidity just as big, in the same storehouse in the same time. Given these discrepancies, the cheese does not maturate uniformly and maturation defects appear. Inside the maturation storehouse we have temperatures between 10-13°C, the temperature variation being of approximately 0.5°C and the humidity of approximately 0.7%. The cold room where cheese is stored cold is efficient because the over maturation is stopped, as the maturation happens very slowly at low temperatures. Slicing is much easier when the cheese is cold. The improvement to the maturation storehouse by chambering it is efficient, bearing as witness the much accelerated maturation and shorter maturation time for the product to reach the qualities and composition that we wanted. The 60-90 days traditional maturation period has been reduced to 34-36 days using the chambered method.

During the maturation process of the Gouda type cheese two stages can be distinguished: the first stage represents the first 15 maturation days, that is characterized by a sudden change of the maturation parameters, and the next 45 days that are characterized by a slow increase in the studied parameters. In other words, by studying the composition of the cheese one can estimate its maturation time.

For the physicochemical analysis, we can say that although the same milk has been used the parameters suffer certain changes, the traditionally maturated cheese having a slower maturation period, the salt is not absorbed as quickly in the cheese mass, the humidity is rather high for this maturation. For microbiological analysis we can conclude the following: although the same milk has been used the parameters suffer certain changes, the traditionally matured cheese has a longer maturation period, but the temperature variation is high and we notice that yeasts and molds appear, the number of E.Coli, coliform bacteria and CP staphylococcus is bigger per total but inside the limits of the national and international laws. Still the most efficient system remains the new one as cheese maturates faster and delivery time is shortened, thus ensuring faster profit.

The fats content in relation to dried substance has grown during maturation. This phenomenon has been noticed both at the naturally maturated bathes and at the new maturation system. The fats content in relation to dried substance (D.S.) is an important factor in the maturation of cheese as a high fat content in the curdle restricts synaeresis so that humidity in relation to the non-fat dried substance has a tendency to rise with the increase in fat in relation to the dried substance.

The water content of the cheese has also decreased until the end of the maturation period, this phenomena has been observed both at the traditionally matured batches and at the one matured in the new system. A high water content in the cheese encourages maturation, but at the same time may lead to the emergence of unwanted flavors in the case of over maturation.

The dried substance content has increased during maturation, this phenomena has been observed both at the traditionally matured batches and at the one matured in the new system.

The salt content has increased during maturation, this phenomena has been observed both at the traditionally matured batches and at the one matured in the new system.

The protein content increases during maturation, they have a role in forming the specific flavor, taste and smell. This phenomena has been observed both at the traditionally matured batches and at the one matured in the new system.

As the quantity of added nitrate decreases we notice an increase in the number of coagulase-positive staphylococci; a possible cause for that would be the lack of inhibitors, but still the values are within normal limits (maximum 1000 UFC/g) according to (EC) Regulation no. 1441/2007. The same things happens with the number of coliform bacteria and yeasts and molds, except that these do not show such an accelerated increase as the coagulase-positive staphylococci.

As the nitrate quantity increases the microbiological parameters are smaller and in these conditions the shelf life of the product can be prolonged. Maybe the best variant would be the one highlighted in A2, that is decreasing the nitrate content to half in relation to the quantity used at present. $NaNO_3$ may be used as a preservative but current legislation regarding this kind of preservative must be observed.

For the microbiological analysis we can conclude the following: although the same milk has been used the parameters suffer certain changes, the traditional maturation takes more time, but as the temperature variations are high we notice that yeasts and molds are formed, the number of E.Coli, coliform bacteria and CP staphylococci is bigger overall, but is within the confines of the national and international law. Still the most efficient system remains the new one as cheese maturates faster and delivery time is shortened, thus ensuring faster profit.

The microbiological criteria for food products are the object of the (EC) Commission Regulation 2073/2005. This regulation is enforced without bothering other special norms regarding microorganism control stipulated in the communitarian legislation and particularly that of the hygiene standards for food products stipulated in the (EC) Regulation no. 853/2004 of the European Parliament and of the Council (2), the norm regarding parasites that have been established by the (EC) Regulation no. 854/2004 of the European Parliament and of the Council (3) and of the microbiological criteria named in Directive 80/777/CEE of the Council (4). These are criteria for food safety and for process hygiene.

For the flavor analysis we can conclude that, the fresher, the “younger” the Gouda cheese is the less obvious the flavor is, when it is maturated approximately one year the flavor is closer to the Holland cheeses. The more the cheese maturates the more pronounces the nut taste becomes and the color changes from pale yellow to caramel yellow. This flavor is very strong and it is not wanted by Romanian consumers, though it is very appreciated in Holland.

The spice type influences the following maturation of the cheese. Every spice leave its mark on the maturation and the flavor also evolves differently.

Gouda with spice is not subjected to prolonged maturation because the spice ferments after a while.

From an organoleptic point of view the cheeses have been within present norms. At the exterior they had a thin, even paring, cross section the paste has presented fermentation

holes spread unevenly, the core was clean, the color slightly yellow and uniform in all the cheese mass, the consistency not brittle, homogenous , elastic, with taste and smell characteristic and pleasant.

The statistic interpretation of the data has been done with the help of the ANOVA statistical software. The analysis of every batch was made only for fat acids and was performed only on the batches that have been processed with two agitators at 64 rotations per minute compared to the standard batch.

The analysis of the **main components (PCA)** has been made using the Pearson method (n). From the charts the conclusion that natural Gouda, greens Gouda, spicy Gouda and mustard and pepper Gouda have many similarities in regard to the dispersion of the fat acids has been reached.

The analysis of the **linear regression**. Using regression, we have managed to determine the degree of variation of the Y dependant variable when the independent variables change their values (vary). In other words, we have managed to determine how much of the total variation of the dependent is influenced by the variation of the independents. Even more, we have managed to estimate (predict) a value or a range of values of the dependent for certain values of the independents. The charts have revealed that Natural Gouda (figure.7) and Greens Gouda (figure.6) have many similarities in relation to the dispersion of the fat acids, and the regression line of the Spicy Gouda (figure.5) resembles that of the Mustard & Pepper Gouda (figure.4) . From this we can conclude that the type of the spice influences the maturation of the cheese and the best results have been obtained in the case of the cheese processed with two agitators at 64 rotations per minute.

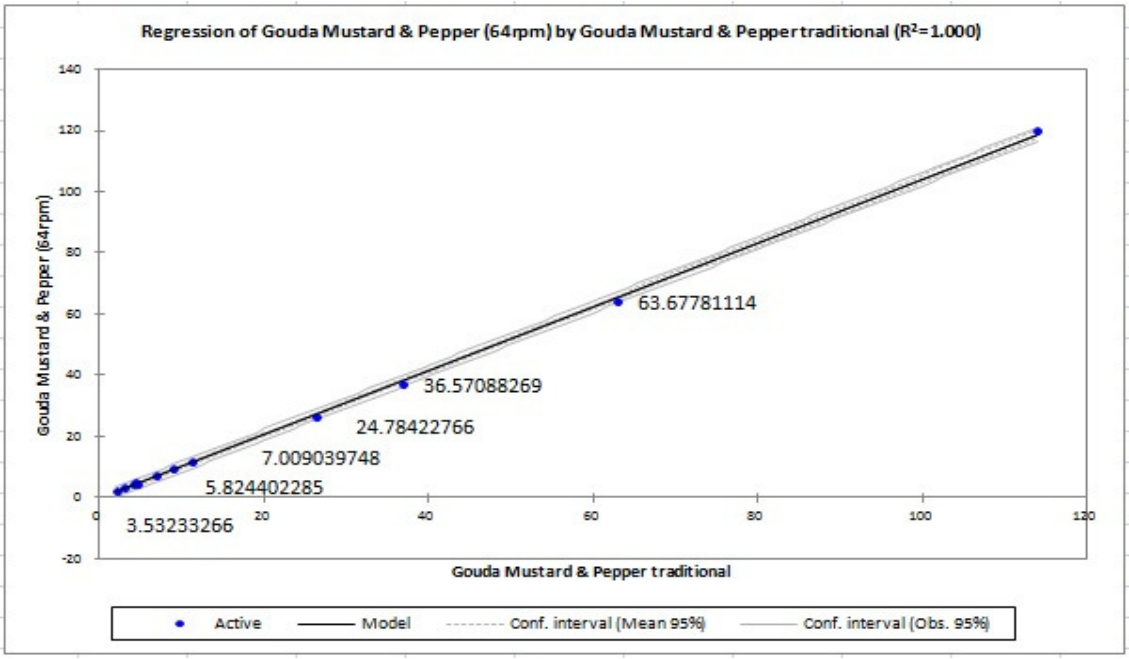

Figure 4. Regression estimated from the sample and the range in which it is a best for Mustard & Pepper Gauda at a confidence level of 95% (personal acrhive).

In the case of a relatively small sample, as in the case of natural Gouda and greens Gouda, the estimation bandwidth is rather far from the regression line. As the volume of the sample increases, as in the case of spicy Gouda and mustard and pepper Gouda, the bandwidth is closer and closer to the line, at big samples it being nearly on the same level.

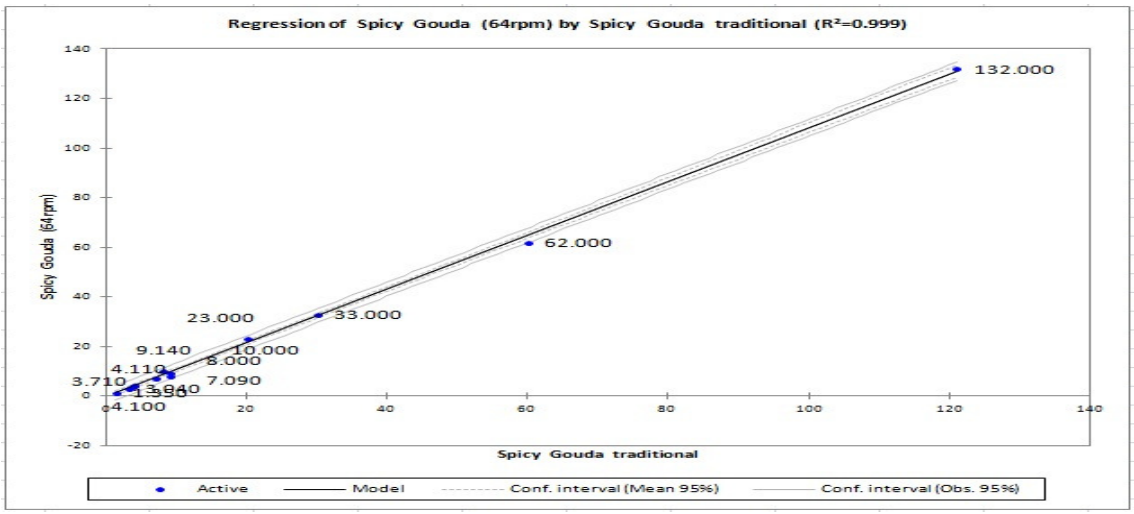

Figure 5. Regression estimated from the sample and the range in which it is a best for Spicy Gauda at a confidence level of 95% (personal acrhive).

The explanation is simple enough as the size of the sample determines a decrease of the standard error, that decreases the level of estimation. It is noticed that the bandwidth is thinner at the m idle; it is normal for it to be so as that is the averages of the two variables, the most stable point of prediction and inference. As an intuitive explanation, the estimation bandwidth is obtained with the help of a "rocking chair" placed at the middle on the averages of the two variables; the ends of the bandwidth are wider due to the up and down movements of the "rocking chair".

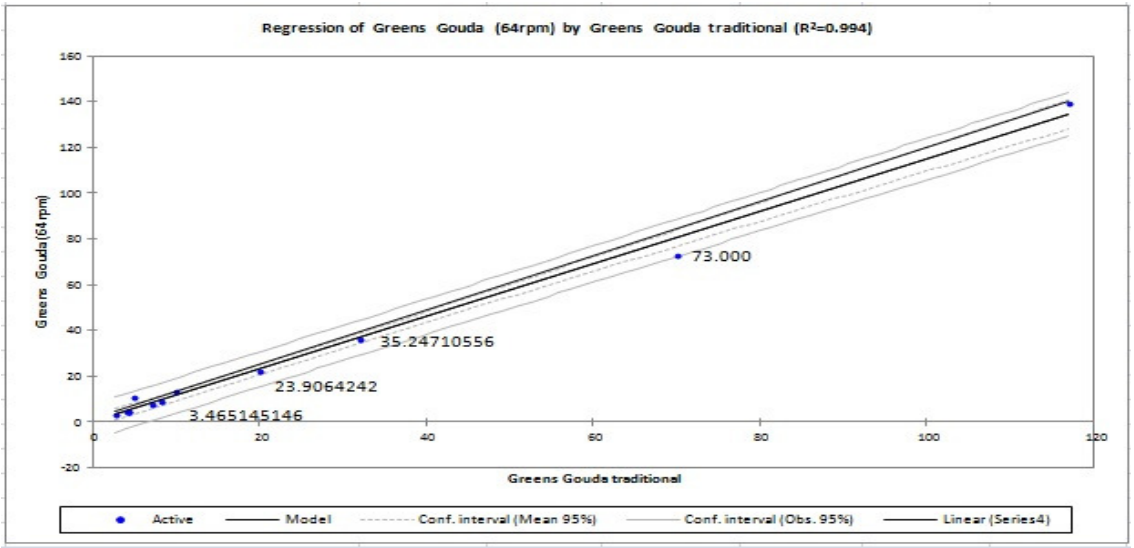

Figure 6. Regression estimated from the sample and the range in which it is a best for Greens Gauda at a confidence level of 95% (personal acrhive).

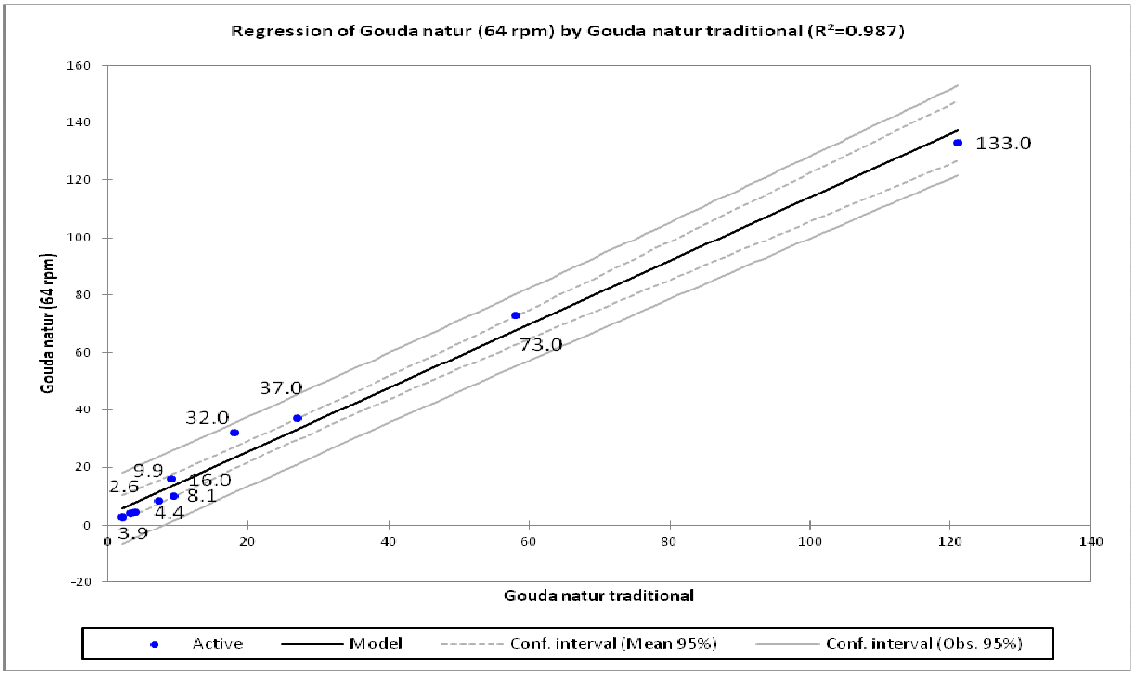

Figure 7. Regression estimated from the sample and the range in which it is a best for Gauda Natur at a confidence level of 95% (personal acrhive).

The fourth chapter of the thesis is represented by main conclusions. Cheese plays a very important role in nutrition. It represents an important source of nutrients, with a high biological value, concentrated in a small volume and with high digestibility. The nutritious value of cheese is given by the high content of proteic substances and fats easily assimilated, calcium, phosphorus, sodium and chlorine mineral salts as well as vitamins. Because of the fat concentration in the curdle obtained by the precipitation of the cazeina, cheese becomes a source of liposoluble vitamins A, D, E, K more important than milk. Based on observations we can draw both theoretical and practical conclusions. The main quality of milk is represented by the nutritious value and is higher as it responds to the needs of the body.

1. It is mandatory that the processing units implement a more rigorous control system for the quality of milk at reception in collecting centers, the analysis of the variation of the antibiotic content proving that milk delivered from people's homesteads presents a higher susceptibility of contamination then the one delivered by farms.
2. It is recommended that a periodic toxicological control of the quality of the milk and the feed supply be implemented, by collecting samples from each supplier, so that irregularities may be identified and eliminated faster.
3. The expansion of the analysis of the raw milk to direct the cheese manufacturing technological process so as the end product has organoleptic, physicochemical and nutritive-biological properties that are specific to the assortment.
4. Maintaining perfect hygiene conditions during the technological flux to reduce the incidence of the pollution micro flora in the working environment, the technological lines, and the products in various processing states.

5. Milk and dairy processing technology is dictated by some reasons linked to the physiology of milk production their involvement in seasonal production where an important role is held by the maximum of production in the lactation curve in relation to grazing or with the excessive production of green mass, and so it is necessary that seasonal milk overproduction be transformed into dairy products with a longer conservation period.

6. Cheese maturation begins in the processing valve, the lactic fermentation phase happens fast during preparation for clotting. By introducing in the pasteurized milk of selected lactic bacteria cultures the maturation process of the cheese can be directed, obtaining products with constant and uniform qualitative characteristics, preventing the influence of daily microbiological variations of the milk on the cheese. All operation after the moment of obtaining the clot have the role of bringing the clot to a compact mass, and in the same time ensuring favorable conditions for the development of specific lactic bacteria that have the enzymatic activity necessary for the wanted transformations of the main cheese components.

7. In the maturation process of cheese there can be distinguished two phases: the first phase, represented by the first 10 days of maturation, is characterized by a slow modification of the values of the parameters, and the second phase, after 10 days of maturation in those conditions, the parameters suffer essential modifications. In other words, by analyzing the composition of the cheese one can estimate its maturation period.

From and organoleptic point of view the cheese has corresponded to present norms. At the exterior it had a thin, even paring, cross section the paste has presented fermentation holes spread unevenly, the core was clean, or with spices, the color uniform in all the cheese mass, the consistency not brittle, homogenous , elastic, with taste and smell characteristic and pleasant.

8. The content of dried substance has increased during maturation for all analyzed assortments. The humidity content of the cheese has decreased during maturation for all analyzed assortments. The salt content has increased during maturation for all analyzed cheese assortments. The fat content in the cheese increases during maturation for all assortments, and the same happens with the fat content in relation to the dried substance in the cheese.

9. In the maturation storehouse we have temperatures ranging between 10-13 °C, the temperature variation is of about 0.5°C and humidity is about 0.7 %. The cold room where the sheese is cold stored is efficient because it stops the maturation, as it happens bery slowly at low temperatues. Slicing is much easier when the cheese is cold.

10. The maturation difference between traditional storehouse and a chambered one is also the small variations of the factors influencing the maturation process. These vary within small limits while in the traditional storehouse there are there are temperature and humidity variations up to 2-3 °C and a humidity just as high, in the same storehouse at the same time. With these discrepancies the cheese does not maturate uniformly and maturation defect appear.

11. Although we have the same animal races and the same growing area, the three markers present variations, which leads us to believe that farmers give a more and more important role to feeding the animals with fodder every year., and the lack of funds for fodder

produces these discrepancies in cattle feed and afterwards in the quality of milk for processing. The same things happens with the milk from our own farms, where the cattle is fed with the same fodder and in the same area conditions. The raw milk in our country present a large variation from winter to autumn. The study was made on 5 months, that is November-march 2011 in the case of our farms, a sample a day has been taken and they have been adequately labeled and the cheese obtained from this milk was also monitored and analyzed. In the case of other suppliers the monitoring cover the period 2009-2011.

From the results obtained we notice that the owned farm presents biological parameters clearly superior to other farms.

Before the maturation period the Gouda type cheese goes through a salting period, a process that takes place in the brine bath. This salting by immersion in brine bath has the role of the ulterior formation of the paring. The period to maintain Gouda cheese in the brine bath differs depending on the ingredients utilized, with the noticed effect that for the pepper cheese the salting period is much longer than for the greens cheese. Natural Gouda cheese has a higher level of salt than the other two assortments because the dehydration of the cheese during the maturation process is higher. The ingredients used in obtaining some assortments of Gouda cheese influence the salt concentration during the salting in the brine bath as well as during maturation.

12. The maturation of Gouda cheese represents the most difficult operation of the whole technological manufacturing process. The protein constitute the base for many flavor compounds. The protein content increases during maturation. The content of total nitrogen decreases during maturation and continues decreasing during the storing period as well.

Given the conditions of present life the responsibility for a healthier life is in the charge of everybody, both the producers that should safer and healthier food, and to the consumers who should direct themselves towards food with less preservatives. Because sodium nitrate is considered a potentially carcinogenic substance, producers have tried to eliminate it from the technological manufacturing process. Eliminating the sodium nitrate from the technological process has lead to a decrease in the maturation and perishability period of the Gouda product. The production costs are slightly reduced but the product must be delivered faster to the client and the maturation period of the Old Gouda (cheese maturated for a long period of time, approximately 8 months).

13. The 3M petrifilm method. **The petrifilm method** is simple, implying similar analysis steps for different categories of food products. If the economic efficiency is wanted, compared to the classic techniques utilizing petrifilms offers the advantage of the analysis of a large number of samples, which leads to more efficiency in the laboratory and to the reduction of analysis costs. Using these modern systems to evaluate the microbiological quality of food allows for the taking of corrective measures during the processing period and prevents marketing the product before the result of the quality control are known. In the case of cheeses made from the milk from their own farms we have monitored the evolution of the following microbiological parameters: Salmonella, CP staphylococci, coliform bacteria, E. coli, yeasts and molds.

Spicy cheese and greens cheese matures faster, the characteristic drawings and fermentation holes appear much faster than in the case of natural cheese. From an

organoleptic point of view the cheese have corresponded to present norms. At the exterior they had a thin, even paring, cross section the paste has presented fermentation holes spread unevenly, the core was clean, the color slightly yellow and uniform in all the cheese mass, the consistency not brittle, homogenous , elastic, with taste and smell characteristic and pleasant. The flavor develops during the maturation period. An important influence in the following development of the flavor is given by the homogenization of the flavor inside the cheese piece.

14. in conclusion, if for the majority of other industrial products the quality is characterized by a one or a group of well defined physical and chemical traits, in the case of food products the quality is determined by three main distinct criteria: innocuousness, nutritious value and sensorial qualities. Sometimes other elements intervene, such as packaging and labeling, that are important for the protection and presentation of the product.

The fifth chapter of the thesis is represented by the personal contribution. My personal contribution for this thesis has been as follows:

- I have analyzed the physic-chemical, microbiological and sensorial parameters of the milk coming from own property farms and from farms from Romania;
- I have found a better homogenization method for the spice cheese mass;
- I have analyzed the modifications that occur in the cheese in the new homogenization conditions;
- The analysis of cheese in the new processing and maturation conditions;
- I have highlighted the utility of the improvements I have made to the pre-press. Adding the two agitators is indeed considered a supplementary cost that is amortized in relatively short time. Considering the number of premium cheese that we have managed to produce with their help, this investment is considered worthwhile. The efficiency of the pre-press mixing also depends on the nature of the spice and the number of rotations per minute of the agitators, rotations that can be adjusted on demand or manually by the client;
- I have analyzed the homogeneity of the spice at different rotations per minute;
- I have analyzed and determined the optimal homogenization parameters;
- I have studied the improvements to the chambered maturation storehouse . they have proved efficient as the maturation process was much accelerated and the maturation period needed for the product to reach the qualities that we have wanted was reduced. The 60-90 days traditional maturation period has been reduced to 34-36 days using the chambered method in the new chambered storehouse;
- I have studied the amortization of the modernization in time and I have reached the conclusion that it s well worth it since the number of premium cheese pieces is increased. This increase is also seen in the selling price of the cheese.

The sixth chapter of the thesis is represented by future perspectives regarding the continuation of the research.

Considering the studies done for this paper, in the future the following modifications to the technological flow maybe done:

- The realization of an automated dosage system of the additions that are used in the computer assisted manufacturing technological flow. A sensor that reads the milk quantity that is in the processing valve that automatically doses the additions and homogenizes the mixture;
- Furthering the analysis methods and implicitly of the analysis used in determining the flavors;
- The study of the influence of certain spice kinds, especially of the spice mixtures, on the following maturation of the cheese;
- The study of other more expensive homogenization methods to reach a 100% homogeneity;

As a consequence of the results obtained we make the following recommendations to improve the quality of the raw milk:

- The creation of a system of traceability that may allow for the noticing and correcting of the risk factors at the farm where the determination results are weak;
- The continuous utilizing of all physic-chemical and microbiological parameters characteristic of raw milk traceability from the four farms;
- The implementation of a raw material safety management.

The sixth chapter presents the bibliography studied for this paper.

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