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"Ph.D THESIS"

RELATIONS AMONG THE PRODUCTION, THE QUALITY AND THE PROCESSING OF SHEEP'S MILK

Submitted by:

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1. The aims of the research

To increase the income of sheep farming can achieved by increasing the quality and quantity of sheep' milk at the same time.

We can enlarge the sheep's milk quantity by the milking more ewes, improvement by cross-breeding using modern farming technology (pasture management, bigger herd, machine milking).

The increase of milk yield make an influence on quality, quantity and market position of sheep milk products, which can cause a positive feed-back.

The aim of our research is to help the Hungarian sheep-farming, to give useful information both in academic and practical fields:

- to increase the profitability of sheep-farming by inreasing the milk production and ewes' milk yield due using Tsiagai genotype,
- to investigate the components of sheep's milk to emphasize the nutritional effects of Tsigai ewes' milk,
- to develop the technology of yogurt from sheep's milk what is a reexplored product called "tarhó" ,
- to determine the effect of Somatic Cell Count of sheep's milk on the product quality and profitability of the producing of sheep milk product.

2. The preliminaries of the research works

On the sufficient part of the world the different sheep milk products are very popular due to their special sensory properties. The sheep's milk taking into consideration its composition, its components' ratio and their

quantities is much more advantageous due to its physiological effects than the cow milk. The mostly well-known and demanded items among the sheep milk products are the cheeses. The sheep's milk can be much more liked for the producers because of its higher protein content and the yield of the cheese is higher than in case of the cow milk processing. Despite these facts the production and the processing of the sheep's milk have been stagnating for many years in Hungary. The explanation of this stagnating can be the low profitability or the lack of the profit. In result of the adverse conditions the registered 3-million sheep population in the mid-eighties dropped to slightly over 1-million one. Of course the decreasing of the population was followed by the reduction of the milk production as well. The yearly purchase of the 20 million liters of sheep milk in the seventies is only a sweet memory comparing to the today's one and a half million liters.

At the same time the products made of sheep's milk are very popular all over the world and in our Country as well. The data derived from the trade prove that the domestic market is capable to take sufficiently more product made of sheep's milk. Besides this the domestic data prove that the significant part – about 30% - of the incomes originated from the sheep farming can be represented by the milk (KUKOVICS and NAGY, 1999.). The generous works made through several decades concerning the cow milk quality certify that the conditions of the good milk quality are the high production and hygienic levels which can produce an income being capable to cover the necessary investments. The logical direction is to develop the milk production but it can bring the optimal results with the improvement of the realization of the meat as well. In opposite case the incomes derived

from the sales of milk have to compensate the possibly wastes coming out from the meat production too.

On the base of the investigations concerning the domestic milked sheep varieties (KUKOVICS et al. 1993, JÁVOR 1994, JÁVOR et .al. 1998, JÁVOR 1998, KOMLÓSI 1998, GULYÁS and KOVÁCS 1998, KUKOVICS and NAGY 1999, GULYÁS 2002), it can be said that to increase the milk production by the cross-breeding of the Merino with milking varieties may be necessary. The autochthonous Tsigai as the possible variety of the milking sheep-farms became the object of the intensively tested varieties. At the end of the nineties in order to develop the milking sheep-farms – besides other varieties - the milk production of the Tsigai was investigated during the thirties, for example PÓCZOS (1934), in the forties FEJÉR (1942) and among the newer research works the activity of KÓSA (1998) must be mentioned.

During the last decades numerous Hungarian and foreign authors reported about the composition and propeties of the sheep's milk. We can consider the earlier reports of domestic authors as basic works like CSISZÁR (1928), SCHANDL (1937), BALATONI (1963), which provide valuable information about the milk composition of the Hungarian Combed Merino sheep.

The data originated from high sampling-rated experiments were published about the composition of the milk of Combed Merino sheep as FENYVESSY (1992), and furthermore about the composition of the milk of the Merino and the cross-breeding genotypes as JÁVOR (1994).

The milk composition changes during the lactation period were followed (for example by CSAPÓ, 1992; FENYVESSY, 1992; MUCSI, 1997; BEDŐ at al. 1999). One of components were especially investigated by numerous authors. DÖRNERNÉ (1954), CSAPÓ (1992) dealt with the vitamin content and CSAPÓ (1992) investigated the content of the minerals in the sheep's milk.

During the last decades the milkfat in the cow milk and its composition was thoroughly studied but regarding the sheep milk's fatty acid composition much less publication was appeared. According to the statement of some authors the fatty acid composition of the sheep milk is similar as the cow milk's one (ADRIAN, 1973; BALATONI and KETTING, 1981; RAMOS and JUAREZ, 1984). Others established sufficient differences regarding the fatty acids comparing to the cow milk's fatty acid composition (MORRISON, 1968; BIACS, 1976; POSATTI and ORR, 1976; SAWAYA and SAFI, 1984; SAWAYA and KHALLIL et al, 1985; SVERN, 1979). In opinion of some authors first of all the more favorable physiological determination of the sheep milk's fat comparing to the cow milk can be explained by its higher ratio of unsaturated and 4-12C fatty acids (FENYVESSY, CSANÁDI 1999; HANLEIN 2001.).

We could find only one data in the scientific literature concerning the composition of the Tsigai milk fatty acids (KUKOVICS 2004c).

In bigger quantities of the D-amino acids as a component of milk and milk products were proved in animal tests as toxic but the human relations are known not exactly. The food stuffs are the well-known sources of the D-amino acids and the application of some technological operations evidently

increase their quantity. The individual D-amino acids of the cow milk and the cow milk products were investigated by several researchers (e.g. STEIBERG et al., 1981; BADA 1985; PALLA et al. 1989; GANDOLFI et al. 1992; BRUCKNER and HAUSCH 1990; CSAPÓ et al. 1995; 1996; 1997) but we do not have data about the D-amino acid content of the sheep milk.

The effect of the sheep's milk composition and quality on the different milk products was investigated by very few researchers. As far as mostly cheeses are made of the sheep's milk so the dominant part of publications relate to this product group.

FENYVESSY (1992) worked out an equation estimating the yield of the Kashkaval cheese from sheep milk, while PIRISI et al. estimated with very close correlation the production yield of the Pecorino Romano and the Pecorino Sardo cheeses on the base of the protein and fat content of the milk. Among the recent publications BENCINI (2002) characterized the sheep's milk coagulating capability by the renneting time, the hardness of the acid gel and its consistency and he experienced sufficient deviations comparing to the cow milk.

AULDIST et al. (1996) reported about the lower thermal stability of the milk originated from last third of the lactation period and the perceptible changes during the storage.

The research works concerning the milk from cow's suffering mastitis were extended to screening the animals showing sub-clinical phenomena and to the evaluation of the methods of protection against the diseases and the effects on the technological operations (EMBAREK et al., 1989;

MERÉNYI and VÁGNER, 1989; SZAKÁLY, 2000). Several publications can be found in relation of the goat milk as well (ZENG and ESCOBAR 1995; OULD ELEYA et al. 1995; KALIGRIDOU et al. 1995; RYNIEWICZ et al. 1995; WOJTOWSKI et al. 1995). Only very limited data can be found concerning the sheep's milk.

The research works investigated the effect of the hygienic quality on the milk composition too (KUKOVICS et al. 1995; DE LA FUENTE et al., 1998).

Nowadays our knowledge is not satisfactory and enough about the occurrence grade of the sheep's milk originated from an infected udder and mostly about the occurred unfavorable effects of the high Somatic Cell Count on the dairy processing.

We did'nt find publications about the relations between the hygienic quality of the sheep's milk and the production and the quality of fermented products.

3. The methods of the research

3.1 Farming and feeding of the sheep, sampling

The investigations concerning the Tsigai's milk production, the milk composition and its quality we took the samples from the sheep herd on Makó-Rákos of Mr. János Dani shepherd.

The milking was made by hand and the udders were fully emptied. The samples of the mixed milk represented the daily production (morning + evening milking).

For the individual investigations we selected 12 ewes having average ability. By this way we wanted to avoid the overestimation of this variety. Due to the problems during the lactation and the earlier drying-off we could use the results of 5 ewes only.
The herd was held in free and they spent the night in the sheep-pen only. The feeding was based on the grazing and was characteristically extensive type. Depending on the weather and the available pasture in most necessary cases we gave additional fodder (0.2-0.3 kg/ewe).

3.2 Investigations of the raw milk

The individual milk samples were taken from the selected ewes of a mixing genotype Tsigai population in the Makó-Rákos during the years 2000 and 2001. The raw milk samples were collected on the spot according to the MSZ EN ISO 707:2000 standard.

We tested the quantities of the milk's main components (protein, fat, lactose, ash, solids and the non-fat soids according to the IDF Standard 141B:1996) pH-value and the acid grade (MSZ3707:1981), the presence of antibiotic residues (MSZ 3708:1983), the freezing point (MSZ 3738:1982), CFU (colony form units, MSZ ISO 6610:1993) and the Somatic Cell Count (SCC) (MSZ EN ISO 13366-2:2000). For the investigation of the raw milk samples we used instrumentation accredited for the raw milk qualification. The detection of the antibiotic components was made by the "Delvotest Multi SP" set.

3.3 Preparation of the sheep milk yogurt samples

Yogurt made from sheep's milk was well known in early part of the last century (GRATZ 1930), but nowadays it is forgotten in Hungary.

During the preparation of the yogurt we used pasteurization on temperature 75°C for 5 minutes and afterwards the milk was homogenized in optimized pressure of 120 bars. The fermentation process was made by means of *Lactobacillus bulgaricus –Streptococcus thermofilus* cultures on 45°C temperature up to 4.6 pH after which the ripening was made on 8°C temperature for 24 hours.

3.4 Determination of the D-amino acids

To investigate the effect of the heat treatment on the raw milk was processed by the so called "LTLT" (Low Temperature Long Time) procedure on 60°C for 15 minutes; by the so called "HTST" (High Temperature Short Time) procedure 70°C, 80°C for 1 minute and by sterilizing on 120°C for 10 minutes. So we could investigate the effects of three different thermal treatments generally used in the dairy firms. The investigated products – except our own made sheep milk yogurt – were bought from the producers or from retail trade.

The D-amino acid content of the freeze-dried samples was determined at the Institute of Chemistry of the Faculty of Veterinary Science at the University of Kaposvár by high performance liquid chromatography using fluorenyl-ethyl-chloroformate (CSAPÓ, EINARSSON 1993) and by precolumn derivation using chiral reagents o-phthalaldehide/tetra-O-2,3,4,6-tetra-O-acetyl-thio-β-D-glucopyranose (FOLESTAD et al. 1994).

3.5 The investigation of the effect of ˙Somatic Cell Count on the cheese yield

Production of the experimental cheeses

For each production we used 8 liters of milk which was heat treated on 65°C for 20 minutes and the addition of the cultures and additives was made on 30°C.

After 2-hours ageing of milk we made the inoculation and further we performed the usual unit operations concerning the production of a typical semi-hard cheese. The salting was made by 22% brine having 5.6 pH-value on the temperature 16°C in every case for 20-hour duration.

Investigation of the production yield

The production yield is understood as the percentage ratio of the cheese produced from 100 liters milk being in the cauldron. The produced yield value was determined after the salting, the drying of the cheese surface by weighing of its mass.

3.6 Analysis of the fatty acids

The fatty acid analysis of the samples was made in the Institute of Chemistry of the University of Kaposvár.

Preparation of the samples: The samples were destroyed in hot water bath with concentrated hydrochloric acid and mixed with ethanol. Afterwards the lipids extracted by ether and petrol ether (b.p. < 60°C). After combining the organic phases the solvent was removed by means of a rotating vacuum evaporator.

Hydrolysis and ester formation: The evaporated samples were boiled with 0.5M methanol sodium hydroxide solution (appr. 5 minutes) and further the boiling was continued for 3 minutes with 14% methanol boron-trifluoride solution. We boiled for another 1 minute adding dried hexane and after cooling down mixed it with salted water solution. After separation of the phases we took 0.5 – 2 µl sample from the organic phase and injected it into Chrompack CP 9000 gas chromatograph.

3.7 The investigation of the texture of yogurt

To characterize substance properties of the yogurt made of sheep's milk we investigated the whey leakage and some other parameters which could be defined by instrumentation. We investigated the effect of the Somatic Cell Count and the different homogenizing pressure on the texture properties as well as the effects on the texture properties.

Investigation of the whey leakage

The higher grade of the whey leakage means quickly aging of acid gel and poorer product. During our investigations we used the method of AL-KHAJAFI et al. (1977).

Texture profil analysis

The QTS 25 texture profil analyser (CNS Farnell, England) is a well-used instrument for investigation of the fermented products from cow milk in our former works therefore we used it for the investigation of the yogurt from sheep's milk as well. The important factor of the measurement is that the selected probe body penetrates into the product with a pre- determined force and into a pre-selected depth.

The applied parameters in the investigations of the yogurtfrom sheep's milk

Probe body: plastic cylinder with diameter 1.2 cm; type of testing: penetration; the moving speed of the probe body: 30 mm/min; trigger: 0.5 g; penetration depth: 25.00 mm; number of cycles: 1; testing temperature was the theoretical eating temperature, e.g. 10 ± 1°C. The measurements were made concerning the different effects of the Somatic Cell Count in two repeat, and in case of the different homogenizing pressures in 5 repeat, and for the evaluation of the derived data we took into consideration the average values of these repeated measuring).

Among the possible 15 parameters generated by the instrument for the characterization of the yogurts we applied the following ones: *Hardness, Adhesive force, Adhesiveness.*

3.8 Mathematical and statistical methods

We used the MS Excel and Statgraf programs to process the data files of the substance values. To prove the connections between individual parameters we prepared a correlation matrix. We investigated the effects of the ewes, the year and runoff of the lactation period on the milk production by three-way Analysis of Variance, while the effect of the ewes and the lactation on the produced milk components was made by two-way Analysis of Variance. We tried to approve by means of the linear regression the effect of the Somatic Cell Count on the cheese production yield. For estimateing the performance of the milk production (milk, fat, protein, etc. Production) parameters during the lactation period the Trapezoid Method

were used. The graphic illustration was made also using the MS Excel and Statgraf softvares with the appropriate conversation.

4. The main conclusion of the present dissertation

4.1. Milk production of the Tsigai ewes

The results of the investigated Tsigai ewes milk production was behind the values of publications available in the bibliography concerning the milking sheep genotypes. But the Tsigai is able to produce much more milk than Merino even in extensive condition as well.

Our results verified that the half of the Tsigais could be milked in average for 131 days after the separation of the lambs (day 30.). The ewes are capable to produce during the lactation period 102 liters which corresponds to daily 0.78 liter. On our opinion we have proved that with the farming of the Tsigai population the produced milk quantity could create the possibility of the profitable sheep farming.

4.2. The composition of the Tsigai's milk, production indexes

We found sufficient differences between the compositions of milk from the individual ewes during the milking period. Taking into consideration the content (%) of milk component in ewes' milk on the same sampling day we can expect the highest deviation figures as: protein content 0.89%; fat content 2.19%; lactose content 0.33%; nonfat solids 1.29%, while in the total solids 3.48%. The figures of the Coefficient of Variance (cv%) deviation prove that in case of the highest deviation can be expected in fat

content while the lowest deviation can be appeared for the lactose content. The trend in the milk composition was in conformity with the expectation during the milking period and in accordance with the relevant literature. We have got the highest values in case of the main components (proteins, fat, lactose) at the end of the lactation period (with the lowest milk production), while the lowest values were registered during the peak period of milk production.

On the base of our results, our valid conclusions regarding the Tsigais held on the Hungarian Great Plain are as following. Sufficient differences can be expected concerning the milk composition and between the ewes during the milking period. At the end of the lactation the following values can be expected: the highest protein content 6.35%; the fat content 9.37%; the lactose content 4.98%; while the non-fat solids 12.19% and the total solids would be about 21.56%.
The average milk composition relating to the milking period was supposed around the following values: fat content 6.97%; protein content 5.44%; lactose content 4.80%; ash content 0.95%; non-fat solids 11.19% and the total solids 18.16%.

According to our results the daily average production rate during the milking period was 51.1 g of fat; 40.7 g of protein; 36.6 g of lactose; 84.3 g of non-fat solids and 135.4 g of total solids. It follows from our results coming out from the summarized average productions that ewe of middling ability during one milking period – with extensive conditions is capable to produce totally 6.873 kg of fat, 5.455 kg of protein, 4.869 kg of

lactose, 11.283 kg of non-fat solids and 18.156 kg of total solids. In our experiments the produced results of the Tsigais' do not reach the values of the milking varieties published in the scientific literature but their values are sufficiently higher than the merinos' ones being predominant in Hungary. On the base of the above mentioned the spreading and the cross-breeding of this variety can be proposed.

4.3. The fatty acid Composition

Investigating the fatty acid compositions of the Tsigais' milk fat we pointed out, that it basically does not differ from the figures published in the literature. The reason of the existing differences can be dedicated to the different genotypes and the environmental conditions (first of all in the feeding). The fatty acids detected in the highest quantities (furthermore as the dominant fatty acids) according to the expectations were the saturated myristic acid, the palmitic acid, the stearic acid and the unsaturated oleic acid, which formed the 77.45 – 78.1 % of the fatty acid quantities. The distribution of the fatty acids was significantly affected by the individual properties and abilities of ewes as well as the progress in the lactation period . Our results derived from the lactation indicate, that the ratio of the palmitic acid slightly changes in the Tsigais' milk fat (cv: 4.23%). During the lactation the quantity of the changes of the stearic acid (cv: 33.51%) were the highest, and the change in the margaric acid (cv:2.69%) was the lowest.

Our results worked out on different nutritional fatty acid groups show the ratio of the unsaturated fatty acids (40.2%) as more as 8% than non-Tsigai value (SEVI et al. 1998), and more than the value reported by KUKOVICS

et al. (2004c) (33.96%). The ratio of the mono unsaturated oleic acids (29.98%) is extremely high, and it is as higher 4% than cow milk's data. The ratio of the linolic acid is 2.2%, while the ratio of the tested poli unsaturated fatty acids was 3.82%.

According to our results the ratios of the unsaturated fatty acids and the oleic acids in the Tsigais' milk are sufficiently higher than in the cow milk and in the merino sheep milk fatty acid compositions described in the literature. In this respect its physiological evaluation is much more favorable in every aspect.

4.4. The investigation of the D-amino acids

Considerable quantity of the free amino acids can not be found in the raw sheep's milk and in its milk products. The total quantity of the free aspartic acids in the raw sheep's milk was 0.0087 mg/100 g; and the quantity of the glutamic acid was 0.1211 mg/100 g which values were minor fractions of the total amino acid content of the sheep's milk.

The ratio of the free D-aspartic acids (5.92%) and the free D-glutamic acids (2.62%) are in good conformity with the data concerning the cow milks.

The different heat treatments did not result higher than 8% increase of the free D-aspartic and free D-glutamic acid ratio in the sheep's milk. At the same time the results indicates, that the thermal sensitivity of the tested amino acids are differs from each other. In effect of the heat treatment on 120°C the increasing of the D-aspartic acid was 132.6%, while the increasing ratio of the D-glutamic acid achieved the 201.9%.

The content of the free D-amino acids in case of every tested product was sufficiently higher, than in the raw milk which evidently proved the increasing effect of the fermentation on the quantity of the D-amino acids. The quantities of the free D-aspartic acids were found in 16.8 – 39.5%, while the D-glutamic acids were detected in 13.3 – 27.0% ratio relating to the quantities of the total free amino acids. In every tested product we established that the racemization of the aspartic acid was always higher than the glutamic acids' one. It means that the fermentation has a greater affect on the aspartic acid. The yogurts contain in higher rate the tested D-amino acids as the cheeses.

4.5. Development of the yogurt made from sheep's milk

On the base of our results it is unambiguous, that in case of the sheep's milk the different homogenizing pressures sufficiently affect on the substance properties of the sour products (yogurt).

The conclusions derived from the instrumental testing of texture showed that the increasing of the homogenization pressure only up to certain limits could improve the texture parameters, but over this limit they would be worse. The highest hardness was 455.4 g; the adhesive force was 88.6 g; the adhesiveness was 366.1 gs; and these figures appeared in the case of the samples homogenized at pressure of 12.0 Mpa (120 bars). The changes in the substance properties show a maximum curve on the base of which the optimal homogenizing pressure in case of the sheep's milk product the 12.0 MPa pressure can be as the optimal one.

Investigating the whey lakeage of the yogurt from sheep's milk we approached to the similar results as in the case of the results from texture analysator. The increasing of the pressure up to 12,0 MPa improved the substances i.e. decreased the whey lakeage.

4.6. The effect of the Somatic Cell Count on the yogurt texture properties and the cheese yield

Investigating the effects of the Somatic Cell Count of the sheep's milk on the texture of the our fermented products (yogurt) we established, that according to the literature data in case of the cow milk the effects of the Cell Count were similar and verified.

According to our findings concerning the whey lakeage, in case of under 1 million/cm^3 Cell number any rough deviation can not be expected. We fixed and evidence a very tight (r^2: 0.931) correlation between the Cell Count and the whey lakeage.

In regard of the effects on the textures properties we have got similar conclusions mentioned in case of the whey lakeage. We have proved the significant correlation between the Somatic Cell Count and the investigated texture parameters. There is a non-proved correlation up to 800,000 /cm^3 concerning the negative effect of the Cell Count. Above the range of 800,000/cm^3 (in case of 1 million/cm^3 concerning the adhesive force) the correlation was very tight, for example in case of the hardness 0.763; in case of the adhsive force 0.816.

Our results derived from the investigations of the sheep's milk concerning the production of the traditional semi-hard cheeses verified that the high

Somatic Cell Count of the milk would decrease the quantity of the cheese to be produced from the same milk quantity.

We have found a significant correlation – 99.9% - between the Somatic Cell Count and the cheese yield corrected to the same solids (r:0.917). Taking into consideration the parameters of the yield we have made a theoretical calculation of losses and we have got the following figures.

In case of an every sheep's bulk milk producing 500,000 /cm^3 increasing in the Somatic Cell Count approximately will cause losses in the cheese production 2.68 kg from 1000 liters of milk, which would produce 8.40 HUF loss per liter sheep's milk (according to the statistical data of year 2004.).

5. New scientific results of the present thesis

1. We have proved, that the milk production and parameters of Tsigais having average ability during the lactation period (protein, fat, lactose, etc.) with unfavorable conditions, with extensive feeding will be sufficiently higher (102 liters milk during the lactation period containing 6.87 kg of fat; 5.45 kg of protein; 4.87 kg of lactose; 11.28 kg of non-fat solids and 18.16 kg total solids) than the dominant Merinos' ones, and better than the other milking cross-breed ones. On base of our results Tsigai genotype can be proposed for the cross-breeding with the Merino.
2. The fatty acid composition of investigated Tsigai's milk is sufficiently differing from the most ewes' milk data published in the literature and it is more advantageous human nutritional

aspects. The ratio of the unsaturated fatty acids is 40.81%, and the poliunsaturated one is 3.82%.

3. According to our results the D-amino acid content of fresh, raw sheep's milk is minimal and it is no affected remarkably by heat treatments . But the Aspartic acid and Glutamic acid in sheep's milk change to D-enantiomers in the different rate due to heat treatment. 0.45-1.32 mg/100g free D-asparticacid, and 0.72-3.70 mg/100g amount of free D-glutamic acid were present in the investigated milk products from sheep's milk. These values represent 16.8-39.5 % D-Asp and 13.3-27.0 % D-Glu ratio on the total tested free amino acids.
4. We developed the technology of yogurt from sheep's milk based on the optimizing of the homogenization pressure. In our experiments 12.0 MPa homogenization pressure was the best in every respect of texture properties.
5. We concluded that the high SCC in ewe's milk spoils the substance properties of the acid gel and results lower cheese yield. Since the properties become worst dramaticaly when the SCC value of sheep milk is higher than 800,000/cm^3, we propose to consider this limit valiu in the development of the quality management systems.
6. We developed a new valuation method for measuring of cheese yield. It is based on corrected equvalent moisture content of cheese samples from different productions.
7. We established an equiation which can be used for estimation of cheese yield in different amount of SCC (but equal protein and fat content) in processed sheep milk.

6. The practical applicability of the results

1. We proved, with investigation of milk production of Tsigai ewes having average milk production that the farming of Tsigai can sufficiently increase the income and by this way the sheep farming can be profitable.
2. Our technological investigations regarding the homogenization of the sheep's milk resulted the product development of the yogurt made of sheep milk. The optimized technology worked out by us can be utilized immediately without any modification in the diaries.
3. We have pointed out that the increasing Somatic Cell Count damages the substance properties of the yogurt made of sheep's milk and the traditionally produced semi-hard cheeses. However this devaluation effect is not sufficient under the 800,000/cm^3 SCC rate. In our opinion this value can be achieved used a modern farming system not too hard so we propose to consider this value as a limit value in the development of the official quality checking system in the future. We gave an estimation equation on base of which in case of the milks having identical composition (protein and fat content) the production yield of the cheese – depending on the Somatic Cell Count – could be estimated.
4. We have worked out a new method in order to obtain correct results for the experiments investigating the cheese yield.

7. Publications related this thesis

Articles

1. Fenyvessy, J., **Csanádi, J. (1999):** A kiskérődzők (juh, kecske) tejalkotórészeinek táplálkozási megítélése. Tejgazdaság LIX. évf. 2. sz. p. 23-27.
2. **Csanádi, J.,** Fenyvessy, J. **(1999):** A tehén-, juh-, és kecsketej alkotórészeinek összehasonlító táplálkozásélettani megítélése. JATE SZÉF Tudományos Közlemények 20. p. 64-71.
3. Fenyvessy, J., **Csanádi, J. (1999):** A tehén-, juh-, ás kecsketej alkotórészeinek összehasonlító táplálkozás-élettani megítélése. Magyar Juhászat + Kecsketenyésztés. 8. évf.(8) p-2-3.
4. **Csanádi, J. (2000):** Tények és lehetőségek a magyar juhtejgazdaságban JATE SZÉF Tudományos Közlemények 21. p. 36-46.
5. **Csanádi, J**, Jávor, A., Fenyvessy, J.**, (2001):** Adatok a feldolgozásra kerülő juhtej minőségéhez DE Agrártudományi Közlemények (Acta Agraria Debreceniensis) p.67-73
6. **Csanádi, J**., Ménesi, T., Marton, E. **(2001):** A juhtej összetételének és minőségének vizsgálata a magyar Dél-alföldi régióban. Tejgazdaság Vol.:1/2001 p.21-27
7. **Csanádi, J. (2001):** Production and processing of sheep milk in Hungary. Egyptian Dairy Journal Vol. 29 No.2 p.163-170
8. **Csanádi, J. (2001):** Tejelő célú juhtenyésztés a Dél-alföldi régióban. SZTE SZÉF Tudományos Közlemények Vol. 22. p. 12-26.
9. **Csanádi, J.**, Fenyvessy, J., Jávor, A**. (2003):** The D-Amino Acid content of ewe's milk and certain products of ewe's milk. Sheep Dairy News. Vol. 20. No.1. p. 12-15.
10. **Csanádi, J.**, Fenyvessy, J., Jávor, A**. (2003):** Eltérően hőkezelt juhtej és juhtejből készült termékek szabad D-aminosav tartalmának vizsgálata. Acta Agraria Kaposvariensis. Vol. 7. No. 1. p. 31-39.
11. **J. Csanádi**, A. Jávor, J. Fenyvessy, G. Szabó, F. Eszes, I. Bajúsz **(2003):** Changes in the D-Amino Acid content of sheep milk related technologies. Natural Resources and Sustainable Development.

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