# PREVALENCE OF CLINICAL MASTITIS IN A DAIRY COWS AND THEIR ECONOMIC IMPACT

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**Abstract**

*The aim of this study was to analyze the prevalence of clinical mastitis in a dairy farm and the economic implications of this condition during 8 months. Based on the clinical signs, 37% of lactating cows were diagnosed with mastitis and 29 % of these shows relapse. The economic loss due to the compromised lactation and the medical treatment was amounted to almost 25000 Euro / 8 months. The results of the statistical study performed in this work raised an alarm and highlighted the need of introducing control programs, early diagnosis and mastitis prevention.*

**Key words:** *clinical mastitis, prevalence, cost, dairy cow, antibioresistance*

## 1. INTRODUCTION

Mastitis is a disease that can be met all over the world, in all animals, but particularly at the dairy cows (Halasa 2007). The disease may be caused by the interaction of the environment`s factors, of the infectious agents, with the host`s resistence (Erskine 2014). Mastitis manifests itself either clinically or subclinically. The milk`s colour of the normal udder ranges from white to yellowish-white, without floaters, clots, or other macroscopic modifications. These unconformities make the milk not suitable for consumption. The main cause of these unconformities is due to the inflamatory reaction of the udder against to the bacterial infections (Smith, Hillerton & Harmon 2001). Mastitis interfers not only with the milk quantity, but also with the qualitative features such as the composition or other physicochemical factors. In addition to inflamatory cells, mediators of the inflammation, and bacterial toxins that can be found in milk, modifications of nutritional components are encountered. Owing to these, the level of fats, of lactose, casein and of the calcium are decreasing, whereas the level of albumin, sodium, and chloride, increase. The increased levels of lipases, proteases, oxidases, plasmin, and plasminogen can influence the stability of milk, its flavour, and the quality of the processed products. (Nune 2013; Stephen 2012). The lesions that can occur in mastitis can cause the atrophy of the glandular acini or of the affected quarter. (Jones & Bailey 2009).

By definition, clinical mastitis induces the production of abnormal milk, and there is no need to determine the number of somatic cells(SCC); yet, if analysis are made, SCC will exceed 200.000 cells/ ml milk. (Smith, Hillerton & Harmon 2001) For each double increase of CSS there is a decrease in milk production by 0, 5 l (0, 4 l for primiparous and 0, 6 l for multiparous dairy cows) (Seegers, Fourichon & Beaudeau 2003).

The diagnostic of clinical mastitis is based on the detection of the clinical signs of the udder inflammation and of the milk modifications (Akam, Dodd & Quick 1989). Moreover, clinical mastitis can be accompanied by general symptoms: fever, accelerated pulse, decrease in appetite, dehydration, depression, and even death (Erskine 2014). In order to facilitate the activity of the veterinarians, the clinical mastitis has been classified in three groups, having the following prevalence:

- low mastitis (40-50%) - one can notice changes in milk
- medium mastitis (40-50%) - abnormal milk and udder modifications
- severe mastitis (5-15%) - there is also systemic symptomatology (Smith 2015)

Risck factors for the development of mastitis are: physiological characteristics of the cow (breed, udder`s conformation, the number of parturitions), body infections, reproduction disorders, genetic pattern, the environment, the season, the milking equipment and methods, the nutrition. In addition to

this, the genetic plays an important role provided that there is a series of genes active in the defense mechanism of the cows against mastitis (Jones & Bailey 2009, El-Awady & Oudah, 2011). Most often, the pathogenic agents that cause mastitis are transmitted via milking equipment, by the hands of the milker, as well as by the bedding. (Preez 2000)

The cows in the first two weeks following the parturition are at greater risk of infection by 15-20% more if compared to other periods (Nunes et al. 2013). This is a consequence of the metabolic stress, of the hormonal changes,of the sub clinical infections that can relapse, or of those contracted after weaning. (Jones & Bailey 2009, Rollina, Dhuyvetter & Overton 2015). The dry cow period and the early time of milk production represent the best management opportunity for the improvement or for the aggreviation of the udder`s health, and these have consequences for the entire lactation period (Rollina, Dhuyvetter & Overton 2015).

More than 140 various microorganisms can cause mastitis (Nunes et al. 2013), but the most prevalent are the Staphilococcus aureus, Staphilococi coagulaze-negative, Streptococcus uberis, Streptococcus disgalactiae, Corynebacterium bovis, Escherichia coli, Klebsiella spp., Serratia spp., Mycoplasma bovis, Prototecha spp. (Smith 2015).

The mastitis can decrease milk production by 10-15% / cow, but this value has serious economic consequences if a significant number of animals are affected (Nunes et al. 2013). Every year, 3 out of 10 cows are experiencing a clinical mastitis, since this is the most common disease met at dairy cows. The cost of mastitis represents 25% of the economic losses connected to diseases. (Hashemi, Kafi & Safdarian 2011). The udder`s health equally influences the income and the expenses of a farm (El-Awady & Oudah 2011). The economic consequences of mastitis are multiple, such as: the losses of milk production, the cost of the drugs and of the veterinary services, the poor quality of the obtained products, costs for the disease diagnosis at present, as well as the possible decrease of the milk production to the future lactation (Halasa 2007, Schroeder 2012, Erskine 2014). The cost of drugs is usually first felt by the farmer, it differs according to country laws and infrastructure (Hogeveen & Osteras 2005, Seegers, Fourichon & Beaudeau 2003).

The dry cow period is very important in the management of mastitis. It supposes the regression of the udder in three subsequent stages: active involution (fulfilled in 3-4 weeks), the stand-by period of the udder and the colostrum period, 1-3 peripartum weeks, which are defined by development of secretory cells, accumulation of antibodies, and the beginning of milk secretion (Nickerson 2010).

Most often, the antibiotics are used to treat the clinical mastitis. In the dairy cow are used for the treatment or for the prophylaxis of mastitis, a significant quantity of antibiotics, with short or long term action, in the dry cow period. Usually, the therapy is based on the clinical signs, upon the recommendation of the veterinarian, but there are countries, like Sweden, where the antibiotics can be prescribed and used only after the isolation and identification of the pathogenic agent. (Lacy-Hulbert, McDougall & Hillerton 2010).

There is been a global concern related to food safety and to the implications of the antibiotics usage when it comes to the livestock.

General recommendations for the administration of antibiotics have been issued, such as the selection of the specific antibacterials based on lab analyses and the choice of the adequate posology, to avoid/reduce the risk of inducing microbial resistance and to reduce their side effects for humans and animals alike (Constable, Pyorala, & Smit 2008). When it comes to mastitis, it is necessary that the cows be treated as individuals, and not to be treated as groups (Preez 2000). Dairy cows and the current practices of management involved in milk production could be related to the dissemination of the bacterial strain resistant to antimicrobial (Beuron 2014).

## 2. MATERIALS AND METHODS

Our study investigated the prevalence of clinical mastitis in a dairy cow farm from Romania.

The herd is counting 520 of cows - the Holstein-Frisian breed - kept in loose housing, with sand bedding. The farmer performed three milking daily, the average production per cow is 31 liters, the average at peak lactation of primiparous is 35 l / cow and of multiparous is 45 l / cow. The dried off period average is 50 days and the first insemination is at 60 days postpartum. The entire technological flow of production, as well as the health status of cows, are controlled via a computerized monitoring system. The first calving is at 23 months of age. The milking is automatic; it is supervised by two operators who perform cleaning, disinfection, wipping of the udder before and after milking, as well as detecting the clinical mastitis. For the cows presenting signs of clinical mastitis a special tank for milking is provided, and the resulted milk is neutralized; the cows with detected mastitis are controlled by the vet. At drying, the cows undergo therapy in order to prevent or to treat subclinical mastitis. The feeding recipe of the cows is performed by a nutritionist.

In the present study, only the cows with clinical signs were considered; these include changes of milk secretion and mammary gland, changes of the general condition of the cow. The treatments were performed according to therapeutic protocols, established by the vet of the farm. The prescribed therapy was not based on microbiological analyzes that identify the pathogens involved. The survey was conducted over 8 months.

## 3. RESULTS

A number of 193 cows (37%) out of a total of 520 cows monitored for 8 months in the dairy farm were experienced at least once by an episode of mastitis: 34 of them were primipareous cows and 159 multipareous cows (with maximum 5 lactations). Also, 56 cows (29%) experienced one or more relapses of the disease during this period. Therefore, in 8 months (from 12.07.2015 to 06.03.2016) they were registered 249 cases of mastitis. The Fig.1 shows the incidence of mastitis cases, each month of this study (excepting the cases of recurrent mastitis).

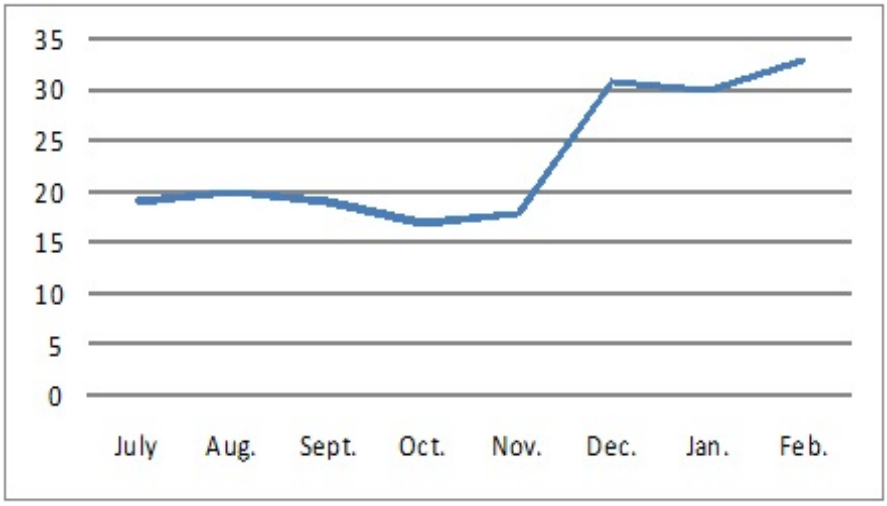



**Figure 1.** The incidence of new cases of mastitis in each of the eight months studied

About 62.5% of the primiparous cows and 50% of the multiparous cows had a lactation period over the group average, in the peak of lactation. The time average of the dry period of multiparous cows was 58.78 days. Still, the variation of this period was very high: the dry period of the multiparous cows (158 cows) was less than 50 days for 31%, for 46 % was from 50 to 70 days, and for 23%, the

dry period was 70 to 135 days. Considering the group of infected animals, for 101 cows (52.3%), the first event of clinical mastitis appeared in the first 60 days of postpartum period, of which 14 cows (7.32%) were primiparous.

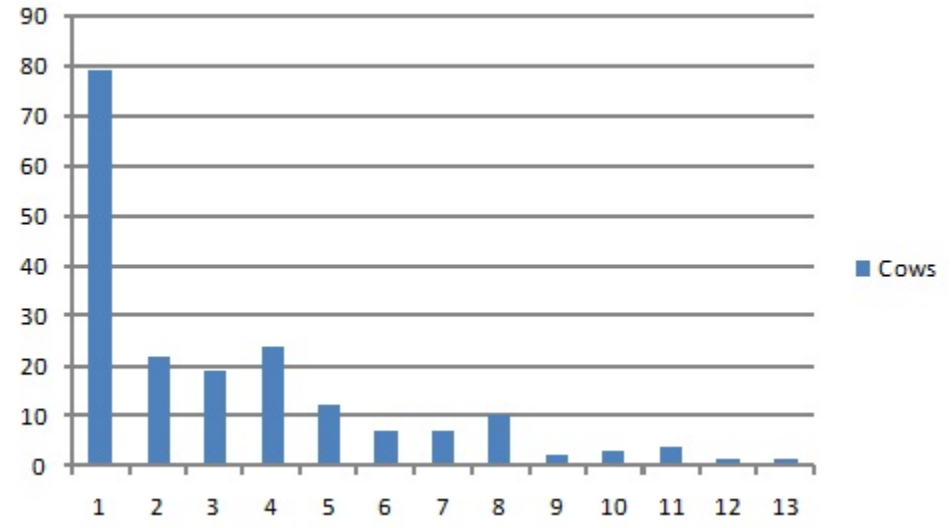



**Figure 2.** Bar Chart representation of the incidence of mastitis cases and the first month of primary episode

All the mastitis cases were diagnosed based on the clinical observations of the vet, given the reduction in the milk yield and alteration of milk aspect as reported by the farm monitoring system, and the changes noticed in the general state of the animal. Generally, one quarter was affected by infection (for 173 cows). For the other 20 animals (11.56%) 2,3 or all quarters were affected.

Thus, four different types of mastitis were found in the dairy farm, according to the aspect of milk: 107 cases of caseous mastitis, 40 cases of serous mastitis, 36 cases of sero-caseous and 10 cases of sero-hemorrhagic mastitis.

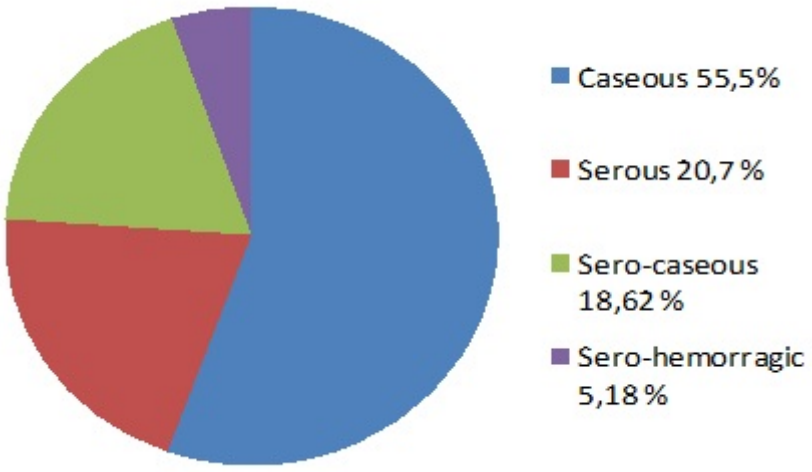



**Figure 3.** Pie Chart showing the types of clinical mastitis diagnosed based on the abnormal milk characteristics

The appropriate therapeutic approach was selected considering the severity of the infection: 127 cows received only local treatment, 40 cows received both local and general treatment, and all the 56 animals affected by recurent mastitis received general treatment. The mild infections are treated using only intramammary infusion; the moderate infections are treated using intramammary and general medication recomended by the vet; the severe infections are treated using general medication (antimicrobial products in association with anti-inflamatory drugs and support solutions). All the animals that were succesfully treated during 8 months received antibiotics like: Cephalexin, Enrofloxacin, Oxytetracycline and Marbofloxacin.

The economic losses considered in this study were primarily the short-term ones, those of the medication costs, and those resulting from the decreased milk yield during therapy and post therapy period (this last overlapping the rest period requested by medication). The milk yield losses were calculated at the farm level as being on average /30 liters per cow.

The medication cost was estimated to 7600 €, considering the type of active substances used in the mastitis treatment and the therapy period (16 € for the local treatment, 56 € for the local and general treatment, and 40 € for the general treatment of relapses). The milk production losses were estimated at 16690 €, calculated to the average production of 30 liters of milk/cow. The farm lost, in average, 0,28 €/liter of milk in the 7 days of local treatment and in the 9 days of the general treatment. The total loss in the 8 months of study was estimated to 24290 €. Moreover, the costs of the decrease of yield milk, of the veterinarian assistance, of the early culling of some cows and other costs associated to mastitis, were not included in this total amount.

## 4. DISCUSSIONS

The usage of the antimicrobial products in the treatment of animals intended for human consumption represents a serious threat for the human health due to the antibiotic residues from meat, conducting to the selection of new antimicrobial resistant bacterial strains (Ruegg 2013). In all the cases of mastitis from the dairy farm, the results obtained within the present study are in accordance with the scientific literature concerning the usage of antimicrobial treatment (local or general). At international level, in 90% of cases, the antimicrobials are used to treat lung infections, metritis and mastitis (Ruegg 2013). Moreover, more than 70% of the antimicrobial products used in dairy farms are meant to treat clinical mastitis (El-Awady & Oudah 2011).

The most commonly used antimicrobials in mastitis therapy belong to the β-lactam class or tetracycline (Soback & Saran 2005). Nevertheless, as our study shows, other antimicrobials that belong to fluoroquinolones class like Enrofloxacin and Marbofloxacin are used to treat severe recurrent mastitis. This is another practice that increases the risk of appearance of resistant bacterial strains to this class of antibiotics. In 2014, WHO reports the existence of bacterial strains resistant to the third generation of cephalosporins and fluoroquinolones (WHO, 2014). Thus, the experts recommend to strictly limit the use of molecules like fluoroquinolones, the third and fourth generation of cephalosporins in animals, this types of antimicrobials being spare-antibiotic for the human health (Constable, Pyorala, & Smit 2008).

Nowadays, there is significant concern regarding the food safety and the effect of using antimicrobials in livestoks. The scientific community pays real effort to limit the antibiotic use for strictly targeted infections (Lacy-Hulbert, McDougall & Hillerton 2010). The antimicrobial resistance makes more difficult the treatment of infections in animals and humans. The misuse of antibiotics (inappropriate selection and posology) represents the main factor in driving to the microbial resistance, without reaching the expected effects in the treatment of the infection. A positive example is Sweden, where the antimicrobial resistance of the pathogens involved in various disorders of livestocks is very low. A significant factor for this progress is the limited usage of antimicrobial products. In addition, the first antibiotic used in the treatment of mastitis is penicillin, if the microorganism is sensitive to this type of drug (Nyman 2007)

In 2014, WHO has adopted a resolution that identifies the urgent need to develop a global plan for

antimicrobial resistance. Far from being apocalyptic scenarios, the post-antibiotics age, when common infections or minor injuries may lead to death, is a real threat in the XXI century (WHO, 2014). The usage of broad spectrum antimicrobials without knowing the sensibility of the pathogen, is undoubtedly, an outdated and dangerous approach. (Hogeveen 2011).

In our study, the treatment of clinical mastitis was generally carried-out using intramammary administration (51%). The other cases (49 %) received general treatment or a mixture of local and general medication. In California, the producers report that over 40% from the treatments used for mastitis are general (Ruegg 2013). Significant number of studies demonstrate the advantages of joining local and general therapy (Soback & Saran 2005). In some cases, the therapeutic results obtained using intramammary administration can be diminished due to the deep tissular lesions caused by inflammation that can reduce the permeation of mammary ducts. The most common therapeutic failures in acute mastitis are generated by the poor distribution of the active molecule in the affected parenchyma, because the canalicular system is blocked by the inflammatory products. (Preez 2000).

The scientific literature recommends a dry period for 60 days, but the tendency of the last years is to reduce it (USDA, 2016, Bernier-Dodier, et al. 2011), considering the cow`s health and the milk production. An American study analyzing the impact of the dry period upon the mammary gland, showed significant differences between the cows weaned at 64,3 ±1 days and the cows weaned at 31,9±1, the last ones having a lower production yielded, a lower energetic value of the milk and a lower consumption level of dry food after birth. Moreover, the same study demonstrates that the quality of the cells of the mammary gland is not affected by the dry period (Bernier-Dodier et al. 2011). In the dry period, the alveolar cells are getting ready for lacogenesis phase. Without the dry period, the onset of milk secretion in the next period is diminished by 20%. Therefore, the dry period is crucial but also beneficial. (Akers 2002). The average dry period of 50 days calculated for the dairy farm monitored in this study is within the limit recommended by the scientific literature. Still, considering the infected animals, the average value of the dry period is variable. The dry period of 31% of the affected cows was less than 50 days (the mammary gland is not enough prepared for milk production). Meanwhile, over 23% of the animals had a dry period between 70 – 135 days (the dry period is too long and the volume of liquids is low, the amount of milk components is also low, the concentration of lactoferrin and antibodies is high, all of these increasing the risk of infection). In the dry period, the udder is not properly washed and desinfected, increasing the risk of infections. The milk accumulation is a proper medium for bacterial growth, the defense system cells being inhibited (Jones & Bailey, 2009).

A percentage of 59.5 of affected quarters was cured by the intramammary therapy using Cephapirin (one of the most frequently used antimicrobial products in the prophylactic treatment over the dry period) in the peripartum period of heifers (Nickerson 2012). Nevertheless, the disadvantage of this therapeutic method is that, in time, new antimicrobial resistant strains will be selected (Anderson & Azizoglu 2014). Other studies show that the incidence of mastitis increases by 10% in the dairy farms were the intramammary therapy is not administered in the dry period (Nickerson 2010).

Bismuth/paraffin seals can be used as an alternative to the antimicrobial treatment of the mammary gland, in the dry period. This way reduced the antibiotic consumption and the incidence of new infections by 50-90% (Nickerson 2010, Hogeveen 2011).

Most of the farmers are milking the cows three times daily, increasing the yielded milk from 3.26 litres to 11.7 liters per milking session (USDA, 2016). In the dairy farm monitored in this study, the cows are milked three times a day at fixed interval (8 hours), maximizing the mammary gland activity.

It has been noticed that the bedding plays an import role in mastitis prevalence. The microbial load is very high in the case of organic beddings, although sanitizing agents are used in comparison to sand beddings were the microbial load is lower but strictly related to organic contamination and humidity (Hogeveen 2011). In the studied farm, the individual stalls are refilled with sand twice a week. Also, chemical desinfection is performed once a week. Still, if we are referring to affected quarters there are no significand differences, as the reported data in the scientific literature. The higher percentage of infections can be correlated with the favorite side of decubitus of the cow (Wilson et al. 1971).

After a mastitis episode, the milk secretion decreases up to 11%, depending on the lactation numbers and the moment when the disease was noticed. The estimated cost as per affected cow is different, considering the analyzed parameters like breed, livestock number of heads, studied region, etc. According to different studies from Sweden, USA, the Netherlands, the economic loss is estimated to 71-95$ or 80-125$. In England, the economic loss is measured at 119 £ for most cases of clinical mastitis. The decrease in the milk yield varies between 183,37 kg -797 kg, depending on the lactation cycle and number of births, and it represents about 5% of the production per dairy period. In Western France, where 197 herds were analyzed, the economic loss was to 78 € for cow per year or 11 € per 1000 l milk. In Denmark, a longer period study was performed on approximately 2500 cows with 5300 lactations, milk production of 7500 liters per cow. The recorded losses were of 527 kg of milk for clinical mastitis in the second lactation

(Holland et al 2015, Seegers, Fourichon & Beaudeau 2003, El-Awady & Oudah 2011, Hogeveen 2011, Petrovskia, Trajcevb & Buneskib 2006) If the mastitis occurs before the peak of lactation, milk losses are higher, if compared to other periods of the onset of mastitis (Petrovskia, Trajcevb & Buneskib 2006). Mortality associated to clinical mastitis is low, 0.22% in France and 0.19% in Northern Ireland; other reports show values between 0.3-0.6%, if the involved pathogens in mammary gland pathology are Gram-negative (Seegers, Fourichon & Beaudeau 2003, Petrovskia, Trajcevb & Buneskib 2006), while anticipated slaughtering to reduce the risk of porting are more common. Costs of slaughtering were estimated at 23% of the total cost of mastitis ((Holland et al 2015, Seegers, Fourichon & Beaudeau 2003). If we analyze the costs in the studied farm over the 8 months, that is 47 € per cow, the costs, that strictly cumulate the economic losses related to treatments and loss of milk during treatment, are very high. If we take into consideration other economic factors, with direct or indirect involvement, the costs will exceed the scientific literature reports by far.

The recommendations for reducing the frequency of mastitis in cows are numerous: hygienic milking, cows slaughtering for those that are chronically infected, a good maintenance, suitable forage ratios, treatment of clinical mastitis based on antibiogram, removal of the cows with chronic mastitis, the therapy of weaned cows, environmental hygiene (Akam, Dodd & Quick 1989). The use of individual wipes for teat disinfection before milking and after milking reduces the risk of further infection by 50% if associated with other control techniques such as moisture environment (Oliver 2012, Rahman et al. 2009, Seegers, Fourichon & Beaudeau 2003). Mastitis prevalence increase with the number of lactations, being influenced by medical history of the animal. Peripartum cows, without history of mastitis, had a prevalence of 39.4%, compared to 86.7% of those with a history of disease. The risk of mastitis for cows with milk fever, placental retention or metritis increase. (Rahman et al. 2009). Farms that invest in the education of personnel incharged with the cow management (specialists or carriers) present a better level of udder health (Petrovskia, Trajcevb & Buneskib 2006).

The benefit is estimated at $ 57 per cow, if available the vaccines to prevent mastitis, assuming that 1% of cows should contract the disease, normally (Petrovskia, Trajcevb & Buneskib 2006).

In order to reduce the incidence of mastitis, it is recommended to supplement ratios at least in the last two weeks prepartum with 0.3 ppm vitamin E and 4,000 I.U. selenium / day (Batral, Hidirogloul & Smith 1992, Politis 2012).

It should be considered that the present study addresses only clinical mastitis as it has an alarming percentage, but the clinical mastitis represent only the tip of the iceberg represented by subclinical mastitis. Study of subclinical mastitis and of all factors responsible for the occurrence of mastitis will be the subject of further research, as part of a monitoring and more thorough treatment program.

## 5. CONCLUSIONS

The economic losses recorded by the dairy farm in the 8 months of study are really high, over the average value accepted in the efficiency economic studies of this kind of farms. This, if we take into account that in the present survey were included only the short-term losses.

Considering the appearance of lactic secretion, the etiology of mastitis is diverse if we refer to the four

types of mastitis diagnosed. Further isolation and identification of specific pathogen microorganisms is needed. In addition, it is vital to perform a test for determining the antimicrobial resistance of the pathogens before starting the antibiotic treatment. This must become a current practice in order to avoid the lack of response to antibiotics, leading thus to the growth of new antimicrobial resistant strains.

The results obtained in this study suggest the need to develop strict control programs for animal health as well as the development of educational programs on the proper use of antimicrobial.

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