POLISH JOURNAL OF NATURAL SCIENCES
Abbrev.: Pol. J. Natur. Sc., Vol 36(2): 197–209, Y. 2021

THE REASONS OF CULLING OF CATTLE IN DAIRY COWS HERD – A REVIEW

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Key words: dairy cow, culling, economic biological reasons, bovine diseases.

Abstract

The culling of cows is an important element in dairy farming, which has a huge impact on the progress of breeding. Culling of animals in the herd is understood as the removal of the animal from the herd as a result of selling the animal to another farm, slaughter and death or euthanasia of animal. The reasons for culling can be divided into voluntary and involuntary or the division into economic and biological reasons. Economic culling (voluntary) is a conscious action of the breeder aimed at increasing the breeding and functional value of the herd, while biological culling is connected with occurrence of metabolic and infectious diseases as well as reproduction and limbs problems or sudden deaths of the animal. In recent years, biological culling has caused significant economic losses to the herd. Improving this can be achieved through intensive prevention and herd health monitoring.

Introduction

The culling of cows is an important element in dairy farming, which has a huge impact on the progress of breeding. At the same time, it can cause significant economic losses (OLECHNOWICZ et al. 2011). The elimination of cows from the herd is a topic rarely undertaken by veterinarians, but very important to breeders. A veterinarian has a great influence on the decision on culling in the herd. The aim of the study was to present the main reasons for the culling of dairy cows and the factors influencing the decision. Knowing the causes of culling by a veterinarian in a herd allows to know the main problems occurring in a herd, which enables effective treatment and prevention of problems. This information can improve the welfare and performance of the cows.

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Culling definition

Culling of animals in the herd is understood as the removal of the animal from the herd as a result of selling the animal to another farm, slaughter and death or euthanasia of animal (FETROW et al. 2006). The decision to eliminate animals from the herd is one of the most important decisions for the breeder, affecting the economics of production and breeding progress. The reasons for culling can be divided into voluntary and involuntary or the division into economic and biological reasons (FETROW et al. 2006). Economic culling (voluntary) is a conscious action of the breeder aimed at increasing the breeding and functional value of the herd, while biological culling (involuntary) is connected with occurrence of metabolic and infectious diseases as well as reproduction and limbs problems or sudden deaths of the animal (POKORSKA et al. 2012).

According to world data, the level of cows culling in the herd should be between 25-35% (ROGER et al. 1988), which is confirmed by the results in the publications: United States 35% (BASCOM et al. 1998), Canada 19.9% (CRAMER et al. 2009), Great Britain-Scotland 33.7% (CHIUMA et al. 2013), 25% (Bell et al. 2001), 31.6% in Finland (RAJALA-SCHULTZ et al. 1999). In literature there are different data about the level of culling of cows in Poland, from 7.31% to 26.8% (POKORSKA et al. 2012); 20–35% (OLECHNOWICZ et al. 2011); to 26.4% (ZIĘTARA et al. 2013). Culling for biological reasons occurs much more often than for economic reasons. The biological to economic reasons ratio is 68% to 32% (BELL et al. 2010) or 74% to 26% (ANSERI-LARI et al. 2012).

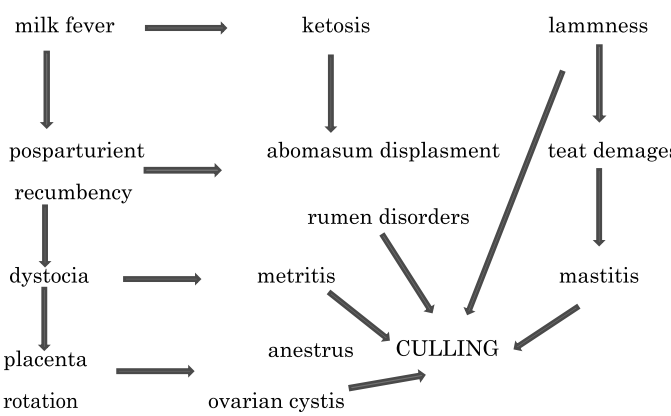

Fig. 1. Relationships between the occurrence of diseases and the relationship between these diseases and culling

Source: own study based on RAJALA-SCHULTZ et al. (1999).

These proportions have changed in recent decades. In the 1980s, the elimination of cows for economic reasons (low production) was the cause of culling four times more often than in the 1990s and in the 21st century. In recent years, biological (involuntary) culling has prevailed. High-yield cows are more often eliminated for health reasons (WEIGEL et al. 2003). This may be related to the fact that for many years increasing the milk yield was the most important in breeding. Selecting only one trait contributed to increase in culling cows as a result of health problems – biological culling.

Factors influencing cows culling

The cows culling decision is complex. Many factors are taken into account, such as: age, number of lactations, stage of lactation, milk yield, health status, reproductive indicators. The elimination of a cow from the herd is also related to economic indicators such as: milk price, livestock purchase price and cost of introducing new animals to the herd. The decision of culling of cows in herd is made individually by the breeder. Sometimes, two farmers having a cow with the same problem may make different culling decisions (BASCON and YOUNG 1998).

The age of the cow and the lactation number associated with that is an important factor influencing culling decisions. Many studies have shown that the older the cow and the greater number of lactation is, the greater is the likelihood that the animal will be eliminated from the herd (ALHMAN et al. 2011, BELL et al. 2010, RILANDO et al. 2020). On the other hand, the analyses of ARMENGOL and FRAILE (2018) and RAJALA-SCHULTZ et al. (1999) showed that the culling increased after the first and second lactation especially, it could be due to elimination of cows with very low yields in first lactation. The high percentage of culling during and after the first lactation may be also related to the fact that in this age group there are the most random cases, understood as accidents and injuries (RILANDO et al. 2020). The poor condition of primiparous cows may be related to the negative influence of diseases during the rearing period (SZULC et al. 1983). Again, the risk of eliminating animals from the herd increases above sixth lactation.

The analysis of Polish authors (POKORSKA et al. 2012) also indicated that the highest percentage of culling is observed in the first and second lactations and amounted to 23.2% (ZIĘTARA et al. 2013) and 23% (JUSZCZAK et al. 2003), respectively.

It should be emphasized that the early elimination of animals generates high economic losses for the farm. Currently, the period of use of cows

in dairy herds is relatively short, averaging 3–4 years and usually not exceeding 6 years (ADAMCZYK et al. 2017). Recently, there has been an increasing tendency in breeding to extend the useful life of cows. Genetic selections in this direction are already underway. It may be related to the strong development of organic farming. In Sweden, organic farming already occupies 6% of the dairy market (ALHMAN et al. 2011).

Another factor influencing the elimination of animals from the herd is the stage of lactation – the day of lactation. Many authors (HERTL et al. 2010, PINEDO et al. 2010, RILANDO et al. 2020) noted in their studies that the highest percentage of elimination of animals from the herd occurs in the first and last months of lactation. It is associated with the occurrence of postpartum complications, metabolic diseases and diseases of the digestive system. Moreover, random accidents in primiparous cows occurred in the first 100 days of lactation and amounted 61.4% of animals (JUSZCZAK et al. 2003). Lactation usually lasts for 305 days, a significant extension of the lactation time contributing to an increase in culling because it affected fertility. Cows culling due to infertility and diseases of the reproductive system systematically increased along with the extension of the lactation period, reaching 57.02% of culling over the 485th day of lactation (SAWA et al. 2012). However, as it was shown by the studies of Guliński et al. and Krzyżewski et al. (2003), extending the lactation time did not reduce the milk production, it even increased the results, reaching an increase of 55.5% with the extension of lactation by 180 days.

Cows culling may depend on the climate and temperature. Cows are more often eliminated in the summer season from May to October (ARMENGOL and FRAILE 2018, PINEDO et al. 2010, SCHNEIDER et al. 2007, ANSARI-LARI et al. 2012). In southern countries such as Spain, the south of the USA the highest percentage of culling is mainly during the summer months, while in northern Europe – in Sweden and Finland, in September – October. Interestingly, it has been noticed that falls in the summer season are higher on farms in France (SEEGERS et al. 1998) and in the USA (WILLIAMS et al. 2015) without heat stress management systems.

Economic reasons for culling

The main cause of economic culling in dairy cows is low milk yield, high somatic cell count or age of cows and disturbances in animal body structure. In the literature, low yield appears as the main cause of economic culling. The percentage of culling for this reason varies in Poland and around the world and ranges from 23.5% in studies in Spain (ARMEN-

GOL and FRAILE 2018) to 2.0 % in Poland (ZIĘTARA et al. 2013). The primiparous cows were most often culled in the first months of lactation (ARMENGOL and FRAILE 2018, POKORSKA et al. 2012). In the following lactations, the percentage of elimination of cows from the herd decreased, increasing successively after 5th lactation. Taking into account the productivity of individual cows, the culling concerned mainly the least productive cows, whose results differed from the average. The culling percentage decreased along with the increase in productivity. Interestingly, after reaching the productivity above 9000 liters culling started to increase again (ZIĘTARA et al. 2013), which could be due to the occurrence of reproductive problems and metabolic diseases in these cows.

Another reason for culling is the age of the cow – old age of the cow, this group including cows over 6 years of age (ALHMAN et al. 2011). In Iran, due to old age, cows over 10 years of age are eliminated, the culling rate for this reason is 8.1% per year (ANSARI-LARI et al. 2012).

Biological reasons for culling

The most common reasons for the biological culling of cows in a herd are reproductive problems: infertility, perinatal disorders, placental retention, miscarriages, as well as mastitis and teat injuries. The next group consists of digestive system and metabolic diseases, such as: abomasal displacement, diarrhea, ketosis, postpartum paralysis, and hypomagnesaemia. In addition, limb problems such as lameness and hoof disease are another reason why cows are eliminated from the herd. The last groups of diseases that affect culling are infectious diseases and other or unrecognized causes, and sudden falls. Figure 1 shows the relationship between the occurrence of diseases and the relationship between these diseases and culling.

Biological reasons – reproductive disorders

According to the literature data, reproductive disorders are the main cause of the elimination of cows from the herd. In Poland, this problem is related to infertility and ranges from 23.4% (POKORSKA et al. 2012), 39.6% (ADAMCZYK et al. 2017) to 44.4% (ZIĘTARA et al. 2013). Worldwide, culling for this reason is also one of the most important, but it varies from 12.5% (RILANDO et al. 2020) to 32.6% (ANSARI-LARI et al. 2012).

Infertility is a separate reproductive problem affecting culling decisions. The presence of anestrus and the presence of ovarian cysts may

contribute to it (BASCON et al. 1998, GRÖHN et al. 1998). The reasons for the elimination of cows from the herd, in addition to sterility, may be: miscarriages, difficult delivery, retention and torsion of the placenta, metritis, vaginal or uterine prolapse and lack of estrus. The probability of eliminating animals for reproductive reasons increases with the age and the milk yield. It is significantly higher above the third lactation (ARMENGOL and FRAILE 2018).

The deterioration of fertility may be influenced by many factors, among the reasons are management and feeding errors, too high milk yield and the animal's genetic characteristics. In addition, infertility may be affected by the occurrence of metabolic factors, such as ketosis or subclinical rumen acidosis.

Culling due to heavy labor, placental retention or torsion, and uterine inflammation are completely time-dependent and due to this, culling occurs in the first month after delivery. Frequency of culling due to metritis as a cause increases at the end of the lactation (RAJALA-SCHULC et al. 1999, GRÖHN et al. 1998), although in the studies of Gröhn et al. (1998) the incidence of uterine inflammation did not have a significant influence on the culling decisions. In addition, sterility was more often the cause of cows' culling on large-scale farms than on smaller organic farms (AHLMAN et al. 2011).

Biological reasons – injuries and inflammation of the mammary gland

Within the pathology of the mammary gland, mastitis is often considered to be the most common disease in dairy cows which contribute to significant economic losses in dairy farming. Teat injuries are the second reason why cows are eliminated from the herd as it causes incread risk of infection which can, in turn, cause subclinical and clinical symptoms of mastitis. For this reason, in Poland culling amounts in 16.13%, and in the world from 22.26% (RILANDO et al. 2020) in Estonia, to 24% in Sweden (SCHREIDER et al. 2007). The problems with the mammary gland were the main cause of cows culling on organic farms in Sweden, amounting to 26.75% (AHLMAN et al. 2011). Clinical mastitis caused by Gram-negative bacterias (*E. coli, Klebsiella*, *Citrobacter, Pseudomonas*) or others such as *Arcanobacterium pyogenes* (now *Trueperella pyogenes*), *Mycobacterium*, fungi and algae may contribute to the loss or death of the animals (HERTL et al. 2011). Mammary gland infections caused by *E. coli* are usually acute or peracute, which can even lead to the death of the animal.

Trueperella pyogenes is a pathogenic agent, which in combination with other bacteria causes purulent inflammation of the mammary gland, called summer mastitis (SMULSKI et al. 2011). Mastitis caused by *S. aureus* is difficult to treat and control because of its ability to spread and penetrate protective barriers, the ability to adhere, to produce enzymes and toxins, and survive in the mammary gland in encysted abscesses. Therefore, one of the ways to combat this microorganism in the herd is to eliminate infected cows. Mastitis as the cause of culling was more common in older cows than in the primiparous cows, it was most common during the second lactation (SCHREIDER et al. 2007). Moreover, HERTL et al. (2011) noticed that a greater number of deaths and losses of a primiparous cows occurs in the first as well as in the 6th and 7th month of lactation because of mastitis. In multiparous cows, he noticed that cows are eliminated due to mastitis most often in the first month of lactation; in the second month this number significantly decreases, while after the third month it systematically increases. He also noted that the cow deaths were more frequent in spring and summer. In the primiparous cows, the most frequently isolated bacteria were *E. coli* and *Streptococcus* spp. In multiparous cows the isolates mainly consisted of Gram-negative bacteria.

In the studies of SEEGERS et al. (1998), cows were eliminated from the herd mostly at the beginning of lactation due to problems with the mammary gland. The highest percentage of cows being removed from the herd for this reason occurred in the 4–6th lactations. When making decisions about culling due to mastitis, the type of treatment, the effectiveness of treatment and the status of pregnancy are taken into account. It was noted that the age of first calving influences the decision to cure (SEEGERS et al. 1998).

Biological reasons – problems with limbs and hooves

Lameness in cows is one of the most common diseases of dairy cattle. The incidence of hoof diseases can be as high as 70–80% of animals in the herd (BEDNARSKI 2013). The elimination of cows due to hoof disease is an increasingly common cause of culling, ranging from 3.6% in Spain (ARMENGOL and FRAILE 2018) to 19% in Japan (GOTO et al. 2015) or 26.24% in Estonia (RILANDO et al. 2020), in other countries, the percentage of cows elimination for this reason is at a similar level: 5.9% in Sweden (AHLMAN et al. 2011), 8.62% in Poland (POKORSKA et al. 2011), 8.1% in USA (PINEDO et al. 2012). Lameness is a disease with a multifactorial etiology, which includes genetic and technological aspects – related to the farm equipment

and the way of keeping and caring for animals, including the feeding of cows. The occurrence of hoof disorders may also be influenced by the presence of metabolic disorders, disturbances of the acid-base balance and mineral deficiencies. Hoof diseases can be non-infectious or infectious. The most common non-infectious hoof diseases in cattle are: laminitis, interdigital dermatitis, plantar and bulb ulcer, extravasation of the hoof capsule, fissures-cracks in the wall of the hoof, white line disease, white line abscess, nails and finger fractures.

The non-infectious diseases of the skin of the fingers and hoof material can become infected and this can even lead to purulent inflammation of the area. The disease is caused by pyogenic and necrotic bacteria – *A. pyogenes, F. necrophorum,* staphylococci, micrococci and *Pseudomonas aeruginosa* and others (DIRKSEN et al. 2009, MORDAK et al. 2008). Major among the infectious diseases are foot rot, caused by *Fusobacterium necrophorum* (DIRKSEN et al. 2009, SIKORA 2013) and papillomatous dermatitis (Mortellaro's disease – the so-called "strawberry" disease or foot warts) caused by *Treponema* spp., *Fusobacterium* spp., *Bacterioides* spp., *Dichelobacter nodosus* (SLAWUTA et al. 2005).

It has been found that non-infectious diseases or injuries are more likely to be the cause of cows culling than infectious diseases (CRAMER et al. 2009). The presented hoof diseases may be the direct or indirect cause of culling. They can cause reduced milk production and its lack of suitability for consumption, weight loss due to lower food intake and poorer feed utilization, fertility disorders, shortening the period of use and increasing the herd repair (OLECHNOWICZ et al. 2011).

Initially, hoof disease may be asymptomatic – without marked lameness or gait disturbance, but they are uncomfortable and painful. This contributes to the reduction of animal welfare, reduces production, and increases the occurrence of metabolic and reproductive disorders. Often, the relationship between metabolic disorders, reproductive disorders, mastitis and hoof diseases is not recognized, and a cause other than hoof disease is mentioned as the cause of culling.

Additionally, it has been noticed that in farms smaller than 20 cows, the culling problem due to hoof problems is smaller and increases with farm size (RILANDO at al. 2020). On large farms, free-standing rearing is predominantly used, which increases the risk of limb diseases (COOK et al. 2003), additionally, walking on hard, contaminated ground in the barn, and long standing during milking increases the risk of hoof diseases. It is believed that culling due to hoof disease can occur throughout the lactation period, while the studies by RAJALA-SCHULTZ and GRÖHN (1999) show that cows are culled for this reason mostly in the second lactation.

Biological reason – metabolic disorders or diseases of the digestive system

The most common metabolic and digestive system disorders causing cows to be culled are: displacement, bloat and/ or torsion of the abomasum, diarrhea, ketosis, fatty liver syndrome, hypocalcemia, hypomagnesaemia, acidosis, and downer cow syndrome (ARMANGOL and FRAILE 2018). These diseases can account for up to 18.9% of the diseases in a herd (GOTO et al. 2015). The rate of elimination of cows due to metabolic diseases and digestive system problems is 7.2% in Spain (ARMANGOL and FRAILE 2018), 2.2% in Sweden (ALHMAN et al. 2011) and 7.88% in Poland (POKORSKA et al. 2012).

These disorders occur much more often in multiparous cows than in the primiparous ones, and the level of culling for these reasons increases with the efficiency and number of lactation and milk yield (RILANDO et al. 2020). Moreover, the occurrence of these diseases depends on the stage of lactation, and most often occurs during the first 30–60 days of lactation.

The occurrence of postpartum paralysis (hypocalcaemia) is directly related to the increased demand for calcium due to the production of large amounts of colostrum immediately after delivery. A poorly balanced diet during the dry period and after parturition leads to severe hypocalcemia (calcium level below 1.5 mmol/L) (BEDNARSKI 2013), which contributes to the occurrence of clinical symptoms such as decreased appetite, weakness, lack of motor coordination. In the next stage recumbence and rumen bloat are observed. Failure to implement timely treatment may result in the death of the animal. The disease occurs up to 48 hours after delivery, therefore culling for this reason occurs in the first 30 days of lactation (RAJALA-SCHULTZ and GRÖHN 1999).

An insufficient amount of magnesium in the feed can lead to the occurrence of grass tetany (hypomagnesaemia). Disease is common especially in pasture-raised cows in the spring season when the grass grows rapidly and contains a small amount of magnesium. Clinical signs such as shakiness, stiff gait, muscle stiffness, muscle tremors can be observed. The next stage of the disease is lateral recumbence and opisthotonus. As in the case of postpartum paralysis, if the treatment is not applied, the animal will die, late treatment may be ineffective, and the administration of magnesium alone may lead to cardiac arrest (BEDNARSKI 2013). The occurrence of hypomagnesaemia contributes to the death of the animal or it is the reason for culling of the animal from the herd, mainly on smaller farms where pasture rearing is prevalent (RAJALA-SCHULTZ and GRÖHN 1999).

The abomasal displacement occurs in the postpartum period as a result of a sudden decrease in the volume of the uterus. The so-called "empty space" created in the cow promotes the displacement of the abomasum. In addition, poor diet, hypocalcaemia, stress, metabolic disorders, and toxaemia predispose to the occurrence of this disease (BEDNARSKI et al. 2013). Symptoms of abomasal displacement involve: decreased appetite and milk yield, weight loss and recumbence. Conservative treatment often does not lead to healing; it is advisable to perform surgery, which generates additional costs. Therefore, the occurrence of this disease may predispose to culling of animal from the herd. Culling due to this reason was around 5.3% Ketosis as the cause of cows culling occurs at a similar level and amounts to 5% (GRÖHN et al. 1998).

Clinical metabolic diseases as a cause of cows culling occur more often in small or ecological farms. In large-scale farms, culling for this reason occurs sporadically, and subclinical forms are much more common.

Biological reasons – respiratory system diseases and other diseases

Diseases of the respiratory system as the reason of culling are rare and their causes are often classified as other, in published studies the percentage of elimination for this reason was 0.7% and it is most common in the primiparous cows. The culling for this reason is usually statistically insignificant (ARMANGOL and FRAILE 2018). Cows that are positive for diseases under infectious disease control programs such as neosporosis, BVD, paratuberculosis or bovine leukemia are eliminated. The culling for infectious diseases is about 1–2%. It was shown that the most common culling for this reason took place in the 4th lactation and was as high as 6.6%. (ARMANGOL and FRAILE 2018).

Biological reasons – accidents on the farm and unknown reasons

Another cause of culling can be severe injuries to equipment, tools or buildings on the farm. This group also includes errors related to wrong administration of drugs, poisoning with chemical compounds. The elimination rate for cows for this reason can be as high as 7.7% (ARMANGOL and FRAILE 2018). Other reasons for the elimination of cows are often understood as: chronic diarrhea, emaciation, arthritis, traumatic reticulo-perito-

nitis, endocarditis, myopathies or septicemia (ANSARI-LARI et al. 2012, WALDNER et al. 2009). In these cases, the exact cause can be established by post-mortem examination

Sudden deaths of cows constitute a separate group in the culling, additional tests are often skipped and the cause of the cow's death cannot be precisely determined. The cause of the cows's death may be one specific factor or it is the result of multiple health problem with the animal. The proportion of undiagnosed causes of cows culling or dying is approximately 4–5% (ARMANGOL and FRAILE 2018, PINEDO et al. 2010, POKORSKA et al. 2012). In the studies of PINEDO et al. (2010) conducted in the United States in the Mississippi region, sudden deaths for unknown reasons occurred in dairy herds of cows more often than infertility and accidents.

Conclusions

High cow productivity has been the main focus of selection in many dairy herds in recent times, leading to adverse effects such as reproductive problems, metabolic diseases and mastitis. This contributed to an increase in biological (involuntary) culling at the expense of economic (voluntary) culling.

Reproductive disorders, in particular infertility, are the main reason for eliminating cows from the herds in Poland and generally in the other countries. Mastitis and teat injuries are the second cause of cows culling from the herd. The elimination of cows due to hoof disease is an increasingly common cause of culling. Metabolic disorders or disease of the digestive system can also be cause of culling, but the elimination of cows for this reason is less than 10%. Diseases of the respiratory system, infectious diseases or others diseases such as: diarrhea, arthritis, endocarditis, myopathies and sepsis, can all be causes of culling, but are not significant.

The biological (involuntary) culling causes significant losses in the dairy farming. To avoid the economic losses for this reason is it very important to conduct monitor and prevention of the herd. Reduction of excessive culling should based on caring for animal welfare by proper feeding of cows in the perinatal period and early lactation, prevention of metabolic diseases and infectious diseases as well as systematic and correct hoof trimming. In addition, very important aspect of biosecurity and infectious diseases prevention is keeping animals in closed system, without any transfers of animals into the herd, using only heifers born in the herd.

Accepted for print 8.05.2021

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