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Incidence, Production and Economic Losses of Clinical Mastitis in Egyptian Holstein Cows

Research Article

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ABSTRACT

This study utilized daily records of 2000 Egyptian Holstein dairy cows. The productive, reproductive and economic data during a whole lactation season were recorded for healthy and mastitis cows. Two risk factors for mastitis were included, parity and season of calving. Mastitis cows had significant (P<0.05) decreased average daily milk yield (26.25 kg) and 305 day milk yield (8006 kg) compared to healthy cows (28.95 and 8829 kg, respectively). Mastitis cows recorded higher calving interval compared to healthy one (413.7 *vs.* 352.2 days). There were significant (P<0.05) increases in total variable costs and total costs of mastitis cows compared to healthy cows. Significant differences (P<0.05) were recorded for partial and collective efficiency measures, veterinary supervision as percent from costs, where high estimates were calculated for mastitis cows (0.89 and 0.80, respectively). Also the total veterinary management as percent from total costs showed more increase in mastitis cows compared to healthy contemporaries (4.22 *vs.* 2.68%). The mastitis cows recorded decreased total returns / total cost % versus healthy cows (108.7 *vs.* 121.4%). Finally, it could be concluded that mastitis had detrimental effects on the productive and economic efficiency of the dairy farms.

KEY WORDS economic, Holstein, mastitis, milk production, reproduction.

INTRODUCTION

Mastitis is one of the most costly problems in the dairy industry. It could be defined as an inflammatory reaction of mammary gland parenchyma that can have infectious, traumatic or toxic nature. Furthermore, it is characterized by physical, chemical and usually bacteriological changes in the milk and by pathological changes in the glandular udder tissue (International Dairy Federation, 1987). The clinical severity can be mild, moderate, severe or permanent (Østergaard *et al.* 2005). Mastitis is an endemic disease in the dairy sector worldwide, causes serious economic losses (Seegers *et al.* 2003; Halasa *et al.* 2007). Nationally, worldwide annual losses due to mastitis have been estimated to be approximately 35 billion US dollar (Wells *et al.* 1998). Several studies have taken all of the direct and indirect costs into account and have produced average figures of $168 (Bar *et al.* 2008), $254 (Huijps *et al.* 2008), and $518 (Hagnestam-Nielsen and Ostergaard, 2009) for the cost of a case of clinical mastitis. All estimates suggest that mastitis is a costly productive disease, but estimates vary greatly because they are formulated using different parameters of loss, different estimation methodologies, and different origins of data. The sources of losses and costs include decreased milk yield, changed milk composition, decreased milk quality, drug costs, veterinary fees, increased labor, discarded milk, costs of replacement heifers, reduced slaughter value, idle production factors and lost future income that results from culling (Schepers and Dijkhuizen, 1991). Many studies have been taken on microbial and preventive aspects of this disease as well simulative form.

However, few studies have been conducted on field data to estimate production related loss and treatment cost (Selvaraju, 2013; Sinha *et al.* 2014). Direct financial losses from clinical mastitis per cow per year within farm ranged from 43.63 to 84.84$. They included losses from discarded milk, cost for drugs, veterinary service, herdsman's time, cost for an extra milking machine and cost for antibiotic treatment in drying off cows. The economic value for the incidence of clinical mastitis ranged from 58.3 to 80.1 $ per clinical mastitis case per cow per year (Wolfova *et al.* 2006). The objective of this study was to analyze the incidence and economics of mastitis in terms of production effects and profit margin of managed Egyptian Holstein cows. Quantification of such economic and production losses not only helps to take preventive measure, but also an extent to avoid loss and improving the profit margin to the farm owners.

MATERIALS AND METHODS

This work was reviewed and approved by the Animal Care and Welfare Committee of Zagzaig University, Egypt.

Animals and management

Data used in this study included daily milk yield (DMY) and clinical mastitis cases of 2000 Holstein dairy cows in 5 private dairy farms belonging Sharkia province, Egypt. Productive, reproductive and economic data were obtained from appropriate records stored in those farms. Cow's parity classified into; primiparous (first lactation) and multiparous (second or higher lactation). Season of calving is defined by 3-month intervals; winter, summer, spring and autumn (Faye *et al.* 1998).

Cows were housed in free stall, had a free access to water and fed a total mixed ration (TMR). The body condition score ranged from 2.5 to 4. The total mixed ration was provided twice / day for the all cows. The ration was mixed daily and modified according to the exact milk production and body condition score of the cows. TMR was formulated to balance the optimum requirements of energy, protein, minerals and vitamins. Monthly, TMR was sampled and analyzed by wet chemistry methods. The primary analysis of TMR include crude protein (16.91%), neutral detergent fiber (24.83%) and net energy for lactation (Mcal/kg=1.76). Alfalfa hay was the primary used forage. The productive and reproductive data were recorded and tracked using a commercial on-farm computer software programs (Afi Farm version 4.1).

Cows were machine-milked 3 times daily in milking parlors. Teats of cows were sanitized by dipping them in 0.5% iodine teat dip or via mechanical sprayers before and after milking. Milk meters recorded individual cow's milk production was stored in a computerized database. Cows detected with clinical mastitis were moved into a hospital pen.

Clinical mastitis was diagnosed if milk from one or more glands was abnormal in color, viscosity, or consistency, with or without accompanying heat, pain, redness, or swelling of the gland, or generalized illness. Based on initial physical examination, each cow was assigned a severity score of 1 (least severe) to 3 (most severe). Affected cows were examined twice daily, within 30 min after machine milking, and severity scores, and treatments were adjusted accordingly (Morin *et al.* 1998). Examinations and treatments were discontinued when a cow received 3 consecutive severity scores of zero (no evidence of clinical mastitis).

Data collection and economic measures

Productive and reproductive traits include average DMY, calving interval (CI), lactation length, cow's parity and 305-day milk yield. Variable costs included feed costs, labor costs, total veterinary management costs (service, treatment, disinfectant and veterinary supervision costs), uncertainly costs that calculated as the value for the cash price and includes the value of animal died, and costs related to production (Atallah, 1997). Cost of services was calculated as: number of services till conception occur × cost of service. Fixed costs included animals, building and equipment depreciations. The depreciation rate calculated on the basis of 25 years for buildings and on 5 years for equipments as: Depreciation rate= value of asset / age of asset (year). Taxes, salaries and interset rates were calculated on the basis of the interest rate 5% ($/cow). Constituents of total costs inculdes the sum of the variable and fixed costs (Tom, 2000). Income parameters of dairy production ($/cow) included; total milk returns= amount of kg milk produced × price of kg milk; value of calves sold per each dairy cow; fecal matter= amount of fecal matter produced cubic meter × price of cubic meter and net income= total return – total costs (Atallah, 2004). Economic Efficiency measures included partial and collective efficiency measures. Partial efficiency measures included veterinary supervision costs / total costs % and total veterinary management costs / total costs % (New, 1991**;** Gilson, 1995). Collective efficiency measures included total returns / total costs % and total × ariable costs % (Lundholm, 2005).

Statistical analysis

All the data were analyzed using SPSS/PCT, 2001 (Foster, 2001). The general linear model (GLM) procedure was used to analyze the productive and economic measures. The model for statistical analyses included the fixed effects of health condition (healthy *vs.* mastitis), season of calving (4 levels) and parity (primiparous *vs.* multiparous). The comparison of means was carried out with Duncan's multiple range tests, after verifying normality using Kolmogorov-Smirnov test.

RESULTS AND DISCUSSION

The risk factors for incidence of mastitis in dairy cows include lactation stage, parity, yield level, previous diseases, season, and contagious spread of the infection from herd mates (Østergaard *et al.* 2005). Mastitis was the only disease having a clear relationship between milk yield and risk of occurrence (Ingvartsen *et al.* 2003).

Parity and season of calving affecting incidence of clinical mastitis

Incidences of clinical mastitis related to the parity and season of calving were illustrated in Table 1.

Table 1 Incidence of clinical mastitis in relation to the parity and season of calving

Factors		Number	Clinical mastitis	
			Number	%
Parity	Primiparous	780	82	10.51
	Multiparous	1220	178	14.59
Season of calving	Winter	715	101	14.12
	Summer	490	56	11.42
	Spring	455	62	13.62
	Autumn	340	41	12.05

Incidence of clinical mastitis was higher in the multiparous cows (14.59%) than in primiparous ones (10.51%). Incidence of clinical mastitis in the current study was lower than recently reported in pure Holsteins and their crosses (El-Tarabany and El-Bayoumi, 2015). This may be due to the fact that the older animals are more susceptible to infection than younger ones, because with advancing age, the udder becomes more pendulous, thus increasing the risk of being injured and exposed to infections by microorganisms. Also, high milk yielders and aged cows are more susceptible to mastitis as its glandular tissues are more susceptible to infection (Radostits *et al.* 2000). The defense mechanism in aged cows is poorer than in younger cows as polymorphonuclear leukocyte function is more active in primiparous than multiparous cows (Dulin *et al.* 1988; VanDorp *et al.* 1999; Fleischer *et al.* 2001; Dego and Tareke, 2003).

On the other hand, earlier report found neither an increasing nor a decreasing risk of mastitis with parity (Kadarmideen and Pryce, 2001). The dairy cows lactating during winter were associated with higher incidence of mastitis than those started during summer.

This may be due to wet season which is suitable for growth and flaring up of the most types of microorganism causing mastitis. Dego and Tareke (2003) also concluded that mastitis was significantly more prevalent in the wet season than in the dry season. Likewise, the overall prevalence of mastitis was 19.9% and 44.8% in dry and wet seasons, respectively. The prevalence of mild mastitis was 17.3% and 40.7%, whereas that of moderate mastitis was 2.6% and 4.1% in dry and wet seasons, respectively (Rahman *et al.* 2009).

Effect of mastitis on some productive and reproductive traits

Overall mean of DMY for mastitis cows was significantly lower than the healthy one (26.25 *vs.* 28.95 kg). Also, the mastitis cows showed a significantly lower DMY than the healthy ones in all seasons (Figure 1).

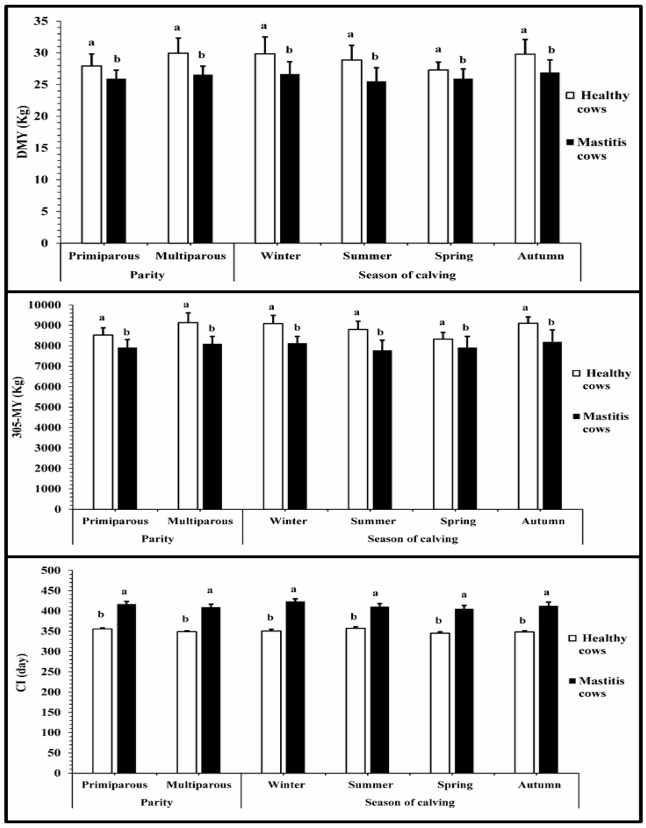

Figure 1 Daily milk yield (DMY), 305-day milk yield (305-MY) and calving interval (CI) for the healthy and mastitis cows in relation to the parity and season of calving

In the same way, the overall mean of 305 MY of mastitis cows was significantly lower than the healthy ones (8006 *vs.* 8829 kg). Primiparous and multiparous healthy cows had significantly higher 305-DMY than the mastitis cows. Also, in different seasons, mastitis cows had a significantly lower DMY than the healthy ones.

These results are in agreement with authors who reported that, losses in milk production for mastitis cows were 341 kg in the first 60 days after the clinical case (Bartlett *et al.* 1991). Furthermore, milk production losses for the rest of lactation following clinical mastitis at nearly 700 kg for the first lactating cows and 1200 kg for the second or higher lactating cows (Wilson *et al.* 2004). Cows contracted mastitis had a daily production advantage of 2.6 kg over their herd mates until they contracted the disease.

These results are in harmony with previous reports which concluded that the average daily milk produced by the mastitis cows (19.20 kg/day) were lower than the healthy one (28.90 kg/day) (El-Tahawy, 2007). Furthermore, the 305-day milk yield of mastitis cows was 5856 kg, compared to healthy cows (8814.50 kg).

In general, mastitis cows had significantly longer CI (413.7 days) compared to healthy cows (352.2 days). Primiparous mastitis cows had slightly higher CI than multiparous mastitis cows; however, both were higher than healthy primiparous and multiparous cows. Similar finding mentioned that the fertility of primiparous mastitis cows was more adversely affected (P<0.05) than pluriparous ones relative to their controls (Barker *et al*. 1998). In different seasons, mastitis cows had higher CI than healthy cows. For calving season effect on CI, the winter showed the highest estimate (423.55 days).

Effect of mastitis on costs and net profit of dairy farm

Variable cost, total cost, return and net profit for the mastitis and healthy cows were summarized in Table 2. Mastitis cows had high variable and total costs due to increased costs of treatment and total veterinary management in comparison with healthy one. Also, mastitis cows had lower returns and net profit than healthy one, probably due to the sharp decline of milk production which never returns again to its peak after treatment. Our estimated production loss for mastitis cows was in agreement with previous studies (Hortet and Seegers, 1998). They reported that, mastitis caused a decrease in the economic net margin per cow (40 to 50%). The largest part of this loss is due to a decrease in milk yield per lactation (5 to 7%). Estimates of milk yield loss ranged from 100 to 500 kg/cow per lactation.

Similarly, Atallah (2004) reported that the total returns of mastitis cows were lower than healthy ones. Primiparous and multiparous cows contract mastitis had significantly higher total variable cost, total cost and significantly lower total return and net profit in comparison with primiparous and multiparous healthy cows.

The multiparous healthy cows recorded the highest net profit followed by the primiparous healthy cow. However, the primiparous mastitis cows had the lowest net profit value. Previous studies stated that the total loss due to mastitis depend on parity and the time of mastitis occurrence (Rajala-Shultz *et al*. 1999).

Similarly, El-Tahawy (2007) stated that the primiparous and pluriparous mastitis cows had significantly (P<0.05) higher variable and total costs compared to their controls. Significant differences between mastitis and healthy cows for the partial and collective efficiency measures have been established in Table 3.

Regarding veterinary supervision related to total costs, there was significant difference between healthy and mastitis cows (0.80 *vs.* 0.89).

Multiparous and primiparous mastitis cows had significantly higher value than healthy ones in different seasons. Also, overall mean of total veterinary management to total costs showed increase in mastitis cows than healthy ones (4.22 *vs.* 2.68). Cows calving in winter season and contracted mastitis showed higher total veterinary management to total cost in comparison with other seasons.

Our results were consistent with previous trial, which demonstrated that the cost of veterinary services to total cost represented about 5.4-5.99% for the diseased cows (El-Hussani, 1992).

Table 2 Effect of mastitis on variable costs, total costs, and total returns per cow in relation to the parity and season of calving

Classifications			Total variable costs (US. $)	Total costs (US. $)	Total returns (US. $)	Net income (US. $)
Overall		H[1]	1523±12.1^{B}	1631±26.8^{B}	1980±26.8^{A}	349±16.8^{A}
		M[2]	1549±30.4^{A}	1657±37.1^{A}	1802±44.7^{B}	144±14.2^{B}
Parity	Primiparous	H	1523±18.5^{b}	1631±45.1^{b}	1914±39.7^{a}	283±30.2^{a}
		M	1549±31.6^{a}	1657±42.7^{a}	1782±42.8^{b}	125±10.1^{b}
	Multiparous	H	1524±15.6^{b}	1632±38.3^{b}	2046±34.4^{a}	415±17.7^{a}
		M	1550±24.8^{a}	1659±37.5^{a}	1822±39.8^{b}	164±11.8^{b}
Season of calving	Winter	H	1521±24.1^{b}	1630±44.8^{b}	2040±30.9^{a}	409±29.1^{a}
		M	1550±24.2^{a}	1659±25.1^{a}	1829±33.2^{b}	172±9.5^{b}
	Summer	H	1523±44.8^{a}	1632±47.2^{a}	1947±42.1^{a}	342±25.1^{a}
		M	1548±25.2^{b}	1656±25.4^{b}	1754±25.1^{b}	98±8.8^{b}
	Spring	H	1524±23.5^{b}	1631±48.1^{b}	1871±42.2^{a}	240±15.1^{a}
		M	1549±33.7^{a}	1657±37.1^{a}	1782±28.6^{b}	124±10.8^{b}
	Autumn	H	1525±25.4^{b}	1633±43.5^{b}	2036±51.4^{a}	403±17.4^{a}
		M	1550±34.5^{a}	1658±45.5^{a}	1844±29.7^{b}	186±15.5^{b}

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
[1] H: healthy cows.
[2] M: cows with mastitis.

Table 3 Effect of mastitis on economic efficiency measures in relation to the parity and season of calving

Classifications			Partial efficiency measure		Collective efficiency measure	
			Veterinary supervision /total costs (%)	Total Veterinary management /total costs (%)	Total returns/total costs (%)	Total returns/variable costs (%)
Overall		H[1]	0.80±0.01[B]	2.68±0.02[B]	121.4±1.2[A]	130.0±1.32[A]
		M[2]	0.89±0.02[A]	4.22±0.03[A]	108.7±1.3[B]	116.3±1.22[B]
Parity	Primiparous	H	0.81±0.01[b]	2.68±0.02[b]	117.3±1.2[a]	125.6±1.16[a]
		M	0.88±0.02[a]	4.19±0.04[a]	107.5±1.7[b]	115.0±1.20[b]
	Multiparous	H	0.80±0.01[b]	2.67±0.02[b]	125.4±1.4[a]	134.3±1.29[a]
		M	0.91±0.02[a]	4.25±0.03[a]	109.8±1.7[b]	117.5±1.35[b]
Season of calving	Winter	H	0.82±0.01[b]	2.72±0.03[b]	125.1±1.9[a]	134.0±1.45[a]
		M	0.87±0.03[a]	4.29±0.05[a]	110.2±1.2[b]	117.9±1.02[b]
	Summer	H	0.79±0.01[b]	2.70±0.03[b]	121.0±1.1[a]	129.5±1.15[a]
		M	0.88±0.03[a]	4.16±0.06[a]	105.8±0.9[b]	113.2±0.98[b]
	Spring	H	0.81±0.01[b]	2.67±0.03[b]	114.7±1.2[a]	122.8±1.12[a]
		M	0.91±0.04[a]	4.21±0.06[a]	107.5±1.1[b]	115.0±1.05[b]
	Autumn	H	0.79±0.01[b]	2.61±0.03[b]	124.7±0.9[a]	133.5±1.13[a]
		M	0.90±0.03[a]	4.22±0.05[a]	111.2±1.1[b]	119.0±1.04[b]

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
[1] H: healthy cows.
[2] M: cows with mastitis.

While, others concluded that the veterinary expenses accounted 1.61% of total costs (Gilson, 1995). Furthermore, veterinary supervision and total veterinary management costs to total costs for healthy cows were 1.01 and 2.57%, respectively, while those for mastitis cows were 0.81 and 2.10% (El-Tahawy, 2007).

CONCLUSION

Mastitis had great depressive effects on the productive and reproductive efficiency of primiparous or multiparous Egyptian Holstein dairy cows in different seasons. Healthy cows had high economic efficiency, while mastitis cows had increased variable and total costs, concomitantly with decreased returns and net profit. Over the past couple of decades, strong emphasis has been placed on the development of mastitis control programs. However, such programs based on 3 main concepts: 1) effect of preventive management programs, 2) effect of altered attitudes of the farmers toward treatment and 3) genetic improvement. In order for Egyptian dairy farmers to prosper in a competitive environment, unnecessary on-farm costs and losses need to be minimized. Quantifying the costs of mastitis to elucidate the losses occurring on Egyptian dairy farms is an important step in motivating farmers to acknowledge the scale of the problem and implement effective management practices aimed at improving mastitis control and reducing the associated costs. Additional research involving alternate antibiotic and supportive treatment protocols in a variety of herds is warranted to determine the most efficacious and cost-effective methods of treating clinical mastitis.

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