Effect of Housing System on Productive and Reproductive Performance of Holstein Cows in a Commercial Herd in Egypt

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SUMMARY

A total number of 693 complete lactation records of 693 Holstein cows were collected from a commercial farm (Dina Farm) during years 2011 and 2012. The aim of the present study was to evaluate some productive and reproductive traits of Holstein cows raised under two different housing systems. The first housing system (FHS) was characterized by the presence of six units of cooling system operated manually with shed height of 4.5 m and 18% shaded area. The second housing system (SHS) was characterized by the presence of 16 automatic cooling system units with a shed height of 8 m and 38% shaded area. Data on 305 days milk yield (305-dMY), daily milk yield (DMY), days open (DO) and number of services per conception (NSPC) were collected and analyzed using XLSTAT.

The overall means of 305-dMY, DMY, DO and NSPC were 8550±330 kg, 26.9±1.04 kg, 147±8.8 days and 3.5±0.25 services, respectively. The difference between both housing systems was significant (P < 0.05) in 305-dMY, DMY and NSPC in favor of the second housing system (SHS), but this difference was non- significant in the case of DO.

Cows housed under the SHS produced 11% higher 305-dMY than those maintained under FHS (8980±390 kg vs. 8120±269 kg). Similarly, cows housed under the SHS had 11% higher (P < 0.05) DMY than those housed under the FHS (28.3±1.23 kg vs. 25.5±0.84 kg). Moreover, cows housed under the SHS had non-significant shorter DO than those of FHS (138±10.4 days vs. 156±7.2 days). Cows maintained under the SHS had lower (P< 0.05) NSPC than those raised under the FHS by 26% (3.1 ± 0.29 vs. 3.9 ± 0.20 services, respectively).

During all seasons, cows housed under the SHS had higher 305-dMY, DMY and lower DO, NSPC than those maintained under the FHS. These results could be attributed mainly to the more comfortable microclimate conditions in the SHS, mediated by more shaded area and effective cooling system.

Keywords: Holstein, production, reproduction, housing systems, commercial farm, Egypt

INTRODUCTION

Improving productive and reproductive traits is the ultimate goal of the dairy herd owners. Egyptian climate is hot and dry. Ambient temperature reaches its highest limit during summer (June -August) and the minimum during winter (December – February). Direct and/or indirect effects of such conditions are reflected on productive and reproductive efficiency, particularly on the exotic dairy breeds (Farooq *et al*., 2010).

Reducing thermal stress is a key process to increase milk production during hot months. Protection from solar radiation by providing adequate shade is the first step in that concern. This could be achieved by applying cooling system and fans in the yards to improve the microclimate around the animals. Hence, comfortable housing conditions are badly needed for exotic dairy cows under hot climatic conditions to improve milk production and reproductive performance.

In Egypt, commercial dairy farms are depended on importating high producing animals, mainly Holsteins and applying appropriate technology in animal husbandry and milk harvesting. Many Egyptian researchers focused on the productive, reproductive and economical characteristics of Holstein cows maintained under intensive production systems in private commercial farms (Sadek, 1994; Sadek *et al.,* 1994; Abou-Bakr, 2009 and Hammoud *et al*., 2010). Yet, few reports are available concerning the impacts of housing conditions on the productive and reproductive characteristics of Holstein cattle in commercial farms in Egypt (Hatem *et al.,* 2004 a & b, Hatem *et al.,* 2006 a & b and Samer, 2010 & 2011). The objective of the present study was to evaluate some productive and reproductive characteristics of Holstein cows housed under two different housing systems in a commercial herd in Egypt.

MATERIALS AND METHODS

Sources of data:

A total number of 693 lactation records for 693 Holstein cows calved during the period from January, 2011 to December, 2012 were collected from Dina Dairy Farm for Agricultural Investment located at El-Beheira governorate, (80 km north west of Cairo, west of Cairo-Alexandria Desert Road, at a latitude angel of 30.14° and a longitude angle of 30.33° on 75 m above the sea level).

Herd management:

The managerial practices of animals maintained under both housing systems were similar. Cows were fed total mixed ration (TMR) throughout the year according to NRC (2001). The TMR consisted of concentrate feed mixture, corn silage, alfalfa hay, Egyptian clover (*Trifolium alexandrinum*) in winter and Egyptian clover hay in summer. Fresh water was available at all the day times.

Heifers were served for the first time when reached about 370 kg of body weight. Frozen semen from Holstein bulls of the best 100 total predicted index bulls in USA and Canada was used in inseminating heifers and cows. Cows were machine milked thrice a day at eight hours intervals (06:00, 14:00 and 22:00 h). Cows were dried off about two months before the expected calving date or when milk yield decreased to less than 7 kg/day.

Housing systems:

Two different housing systems were evaluated in this study. The first housing system (FHS) was an open yard system, consists of nine triangle yards. The base of each triangle was 70 m and its height length was 110 m. Each yard had two shaded areas with corrugated metal sheets. The first shaded area was near to the base of the yard with dimensions of 35 m length, 10 m width and 4.5 m height. The second shaded area was away from the first by about 5 m with dimensions of 42 m length, 8 m width and 4.5 m height. The calculated percentage of shaded area under this system was about 18% of the total area of each yard. The floor of the yards was earthen and covered with sand except a concrete slab of 2 m. Four water bunks were presented under each shaded area, in addition to six units of high-pressure mist cooling system (fogging system) work manually.

The second housing system (SHS) was also an open yard system, consists of eight oblong yards, (126 m length and 53 m width). Each two yards were close proximity and shaded with two corrugated metal sheets. The dimensions of the first one were 122 m length, 13.5 m width and 8 m height, while the second shaded area was located at the western side of each two yards. The dimensions were 122 m length, 7 m width and 5 m height. The calculated percentage of shaded area in the SHS reached about 38 %. The floor is similar to that of the first system except a concrete slab of 4 m. In each yard, there were twelve water bunks and 16 units of automatic cooling system. These units continuously measure the ambient temperature (AT, °C), relative humidity (RH, %) and wind speed (WS, m/s). When these parameters reached definite values the system work automatically as adjusted and formulated by a computer. Cows were allocated randomly to each system.

Temperature Humidity Index:

Data of ambient temperature and relative humidity during 2011 and 2012 were obtained from the Central Laboratory for Agricultural Climate (CLAC), Agricultural Research Center (ARC), Ministry of Agriculture, Cairo, Egypt. Temperature humidity index (THI) was calculated based on the equation of Mader *et al*. (2006) per each season. Where THI = (0.8 × Tdb) + [(RH/100) × (Tdb − 14.4)] + 46.4 , where: Tdb = dry bulb temperature (°C) and RH = relative humidity (%).

Productive and reproductive traits studied:

305-day milk yield:

The 305-day milk yield (305-dMY, kg) was calculated as the milk yielded throughout the first 305 days for cows milking more than 305 days or till the dry date if it occurred normally prior to 305 days in milk. The 305-dMY of cows of incomplete lactations due to selling, death or slaughtering was estimated using the International Committee for Animal Recording equation (ICAR, 2000) as follows:

The 305-dMY = [(TMY X 405) / (100 + LP)], where TMY= total milk yield (kg) and LP= lactation period (days).

Daily milk yield:

Daily milk yield (DMY, kg) was calculated by dividing TMY by LP.

Days open:

Days open (DO, days) was defined as the days from calving until conception.

Number of services per conception:

The services required for conception were recorded for each cow and used to calculate the number of services per conception (NSPC).

Statistical analysis:

Collected data were processed and analysed using XLSTAT (2013). The following statistical model was applied to analyze the productive and reproductive traits:

$$\mathbf{Y_{ijklm} = \mu + H_i + P_j + S_k + Y_l + (HS)_{ik} + e_{ijklm}}$$

Where,

Y_{ijklm}= an observation of the productive or reproductive trait,

μ = the overall mean,

H_i = effect of i^{th} housing system, (i = 1, 2), where 1= the FHS, 2= the SHS,

P_j = effect of j^{th} parity, (j = 1, 2, 3, 4, ≥5),

S_k = effect of k^{th} season of calving, (k = 1, 2, 3, 4), where 1= Winter (Dec. – Feb.), 2= Spring (Mar. – May), 3= Summer (Jun. – Aug.), 4= Autumn (Sep. – Nov.),

Y_l = effect of l^{th} year of calving, (l = 1, 2, where 1= 2011, 2= 2012),

$(HS)_{ik}$ = effect of interaction between housing system and season of calving, and

e_{ijklm} = random errors, assumed to be NID (0, Q^2)

All possible interactions were tested, but only the interaction of housing system by season of calving was significant, therefore the used model included this interaction only.

RESULTS AND DISCUSSION

Temperature humidity index:

Data of temperature humidity index (THI) in different seasons with years 2011 and 2012 are presented in Table (1). The Livestock Weather Safety Index classifications by Mader *et al*. (2006) for heat stress are as follows: normal, ≤74 THI; alert, 74 < THI < 79; danger, 79 ≤ THI < 84; and emergency, THI ≥84. The values of THI in winter, spring, and autumn were less than the minimum threshold of heat stress (normal, ≤74, Mader *et al*., 2006). These values ranged between 55 and 71 units. While, in the summer months of the two studied years, the values of THI were 75 and 78 units (Table 1).

Productive traits:

The least squares means of 305-dMY and DMY of Holstein cows classified by housing system, parity and season and year of calving are presented in Table (2). The overall mean of 305-dMY obtained in this study was 8550 ± 330, which was higher than the values obtained on Holstein cows in Egypt by Sadek *et al*. (1994; 4372±48 kg), Marzouk (1998; 3211±43 kg), Hussein (2000; 4567±137 kg) and Samoul (2011; 6975±50 kg). In contrast, Alhammad (2005) reported higher estimate of 305-dMY (10356±208 kg). The overall mean of DMY was 26.9 ± 1.04, which was higher than the values obtained in Egypt on Holstein cows by Fahim (2004; 23±0.09 kg) and Samoul (2011; 22.8±0.14 kg) and lower than that reported by Alhammad (2005; 33.9±0.88 kg).

Effect of housing system:

Housing system affected significantly ($P < 0.05$) 305-dMY and DMY (Table 2). Cows raised under the SHS, produced 11% higher 305-dMY than those maintained under the FHS (8980 *vs*. 8120 kg). DMY was, also, higher ($P < 0.05$) than that of those raised under the FHS by 11% (28.3 *vs*. 25.5 kg). The present results are consistent with the findings of Hatem *et al.* (2004a) and Samer (2010 and 2011). The first authors found that increasing shed height resulted in increasing DMY. They compared DMY of Holstein cows housed under three shed heights (3, 5 and 8 meters). The corresponding values of DMY were 14.3, 18.9 and 25.1 kg, respectively, which means that increasing shed height from 3 m to 8 m has led to an increase of DMY by about 75 %. They attributed the increase in DMY to the improvement of microclimate under the highest shed.

Samoul (2011) reached, also, at the same results. The author compared 305-dMY and DMY of Holstein cows raised at two commercial farms in Egypt. The author found that cows raised in the first farm under shed height of 5m, and provided with cooling system and shaded area of 40% produced higher 305-dMY and DMY than those housed in the second farm with shed height of 3.5m, non-cooling system and shaded area of only 21%. The values were 7670 and 6280 kg for 305-dMY and 25.1 and 20.4 kg for DMY in the two farms, respectively. The rate of increase was 22% for 305-dMY and 23% for DMY.

Effect of parity:

Parity had highly significant ($P < 0.01$) effect on 305-dMY and DMY in the present study (Table 2). The 305-dMY of the first calvers was 8670 kg, then decreased in the second parity (7755 kg), after that it increased in the subsequent parities. The fourth parity calvers scored the highest 305-dMY and DMY (Table 2). The values were 9180 kg and 29.1, which differed significantly ($P < 0.01$) from the second and the third calvers estimates (Table 2). There was no significant difference between the 4^{th} and the 5^{th} parity concerning 305-dMY and DMY, a finding which may reflect the full maturity of body and mammary secretory cells. Sadek *et al*. (1994) and Marzouk (1998) stated that parity had a highly significant effect on 305-dMY. Sadek *et al*. (1994) found that the differences among parities were significant for 305-dMY which increased with the increase in order of lactation until the third one. On the other hand, Hussein (2000) indicated that the effect of parity on 305-dMY was non-significant.

Effect of season of calving:

Season of calving had no significant effect on the two studied traits. Cows calved in winter season had higher values of 305-dMY and DMY (8840 kg and 28.1 kg, respectively) compared to those calved in the other seasons (Table 2). This may be due to that THI during the peak of lactation (spring season) was less than the minimum threshold of heat stress (Table 1), this means that lactating cows spent most of lactation period in more comfort temperature range with availability of good green fodders. Seasonal variation in animal performance in tropics could be explained by a combination of nutritional inadequacy and heat stress. Comparable results were found by Marzouk (1998) where, winter calvers scored the highest values of 305-dMY and the summer calvers scored the lowest ones.

In Egypt, the influence of season of calving on DMY was found to be significant and as reported by Aly (1995); El-Awady (1998); and Oudah *et al*. (2000).

Effect of year of calving

Although, the values of 305-dMY and DMY in 2011 were higher than those in 2012 (8720 *vs* 8375 kg and 26.6 *vs* 27.2 kg, respectively) in the present study, the difference was not significant (Table 2). Variation in 305-dMY from year to another may be due to the differences in herd size, environmental conditions, management practies, availability of fodders and plan of breeding. Similar results were recorded by Kassab (2001). However, several

Table 1. Temperature humidity index (THI) in different seasons of the study

Year	THI			
	Winter	Spring	Summer	Autumn
2011	58	63	75	68
2012	55	65	78	71

Egyptian workers found a significant effect of year of calving on DMY (Sadek *et al*., 1994; Aly, 1995; El-Awady, 1998; Hussein, 2000; and Oudah *et al*., 2000).

Reproductive traits:

The least squares means of DO and NSPC of Holstein cows classified by housing systems, parity and season and year of calving are shown in Table 3. The overall means of DO and NSPC were 147 ± 8.8 day and 3.5 ± 0.25 services, which means that the overall mean of calving interval of Holstein cows in the present study was about 13.7 months. The obtained value of DO was lower than those obtained on Holstein cows in Egypt by Aly (1995; 190.7±10 days), Marzouk (1998; 152.3±3.43 days) and Samoul (2011; 167±2.3 days), while it was close to that reported by Alhammad (2005) on the same breed in Egypt (147±7.6 days). The present value of NSPC was also less than that reported by Samoul (2011; 6.9±0.1 services).

Effect of housing system:

Cows raised under the SHS, tended to have shorter DO than those of FHS (138 *vs*. 156 days) by 18 days representing about 13%. Cows maintained under the FHS required more (P < 0.05) services than those raised under the SHS by about 26% (3.9 *vs*. 3.1 services) (Table 3).

The results obtained in the SHS could be mainly due to the more comfortable micro environment attributed to using advanced technology to control heat stress, in addition to the increase of shed height and the shaded area. Furthermore, presence of extra shed on the west side reduced the effect of heat stress when the sun tend to the west and thus keep the cows away from the solar radiation relative to FHS. The results obtained by Samoul (2011) were close in trend with the present results. The author found that cows raised under shed height of 5m provided with cooling system and 40% shaded area in a commercial farm had shorter DO (157 days) and lower NSPC (6.4 services) compared to those housed under shed height of 3.5m with non-cooling system and 21% shaded area (176 days and 7.3 services, respectively). The differences came to 12% for DO and 14% for NSPC and was significant (P < 0.05) in the case of NSPC.

Effect of parity:

Parity had no significant effect on DO and NSPC in the current study. The third parity showed the longest DO (155±7.9 days) while the 5th parity calvers showed the lowest one (125±22.6 days) (Table 3). Cows of the second lactation required the highest NSPC (3.9 services), while the 5th parity calvers need the lowest inseminations (2.5 services) for conception (Table 3). Nigm (1990) and Marzouk (1998) found that older cows had shorter DO than younger ones. Hillers *et al*. (1984) indicated that the variation in DO may be attributed to the NSPC, which is affected by reproductive health, heat detection efficiency, insemination time, quality of semen and the inseminator's skills. The authors added that milk production level, age of the cow and season and year of calving, also, affected reproductive efficiency.

Table 2. LSM[1] ± SE of 305-day milk yield (305-dMY) and daily milk yield (DMY) of Holstein cows

Classification	NO.	305-dMY (kg)		DMY (kg)	
		$\overline{X}$ ± SE	P	$\overline{X}$ ± SE	P
Overall mean	693	8550 ± 330		26.9 ± 1.04	
Housing system			*		*
FHS	285	8120^{b} ± 269		25.5^{b} ± 0.84	
SHS	408	8980^{a} ± 390		28.3^{a} ± 1.23	
Parity			**		**
1	184	8670^{ab} ± 300		27.1^{ab} ± 0.94	
2	255	7755^{b} ± 255		24.3^{b} ± 0.80	
3	137	8010^{b} ± 298		25.2^{b} ± 0.94	
4	91	9180^{a} ± 484		29.1^{a} ± 1.52	
≥5	26	9130^{ab} ± 847		28.9^{ab} ± 2.67	
Season of calving			NS		NS
Winter	276	8840 ± 249		28.1 ± 0.78	
Spring	142	8490 ± 872		26.2 ± 2.74	
Summer	113	8570 ± 381		27.1 ± 1.20	
Autumn	162	8290 ± 265		26.2 ± 0.83	
Year of calving			NS		NS
2011	219	8720 ± 486		26.6 ± 1.53	
2012	474	8375 ± 240		27.2 ± 0.75	

[1]= Means within each classification have different letters are significantly different (P<0.05).
FHS and SHS are the first and the second housing systems, respectively.
*= (P < 0.05), **= (P < 0.01) and NS= non-significant

Effect of season of calving:

Season of calving had highly significant effects on DO ($P<0.01$), while this effect was not significant for NSPC. Cows calved in spring season had longer period of DO (183±23.3 days) relative to those calved in other seasons (Table 3). The same trend was found for NSPC, where cows calved in spring season had greater NSPC than those calved in other seasons. This may be due to that the post-partum resumption of ovarian and estrous activities which are coincided with the start of summer months where THI was at high level (Table 1). Juma *et al.* (1988) on Holstein cows reported that the highest number of services per conception was observed in spring calvers. This may be explained by those cows had their breeding period during the hot months (summer season) and heat stress might have been responsible for reducing the reproductive efficiency. The present trend is in consistence with that reported by Marzouk (1998) and Samoul (2011) in Egypt. They indicated that ambient temperature and levels of nutrition were among the factors responsible for the seasonal variation in reproductive traits. In addition, Mahmoud *et al.* (1991) stated that the daily photoperiod length had significant effect on DO period, where, long day light was accompanied with long DO. Short estrus and silent ovulation in hot season add another difficulty to heat detection. Heat stress resulted in poor reproductive efficiency (ovulation rate, repeat breeding and conception rate,. etc). The lowest values of DO and NSPC recorded in this study during the cooler months (autumn and winter seasons) were attributed to the low value of THI found in these two seasons. El-Fouly *et al.* (1976) reported that preparing the animals to have the full chance for conception during the season of full ovarian activity (October - March) could reduce DO considerably.

Effect of year of calving:

Year of calving had highly significant effect on DO and NSPC ($P<0.01$). The DO and NSPC in 2012 were (79±6.4 days and 2.0±0.18 services) highly significant lower than those in 2011 (214±13.0 days and 5.0±0.36 services) (Table 3). This trend mainly represents the differences in strategies of management and feeding system, which are carried out in commercial farms with advanced management system over the years rather than to genetic differences. Significant effect of year of calving on DO and NSPC was reported by El-Nady (1996) and Kassab (2001) on Holstein cows in Egypt.

Effect of housing system by season of calving interaction:

Table (4) shows the interaction effect of housing system by season of calving. It could be observed that the values of 305-dMY of cows raised under the SHS were higher than those maintained under the FHS in all seasons, especially in spring, where the difference (1065 kg) was highly significant ($P<0.01$) (9025 ± 947 kg *vs.* 7960 ± 881 kg) (Figure 1). The same trend was also found with DMY, where cows in the SHS had higher DMY than those in the FHS, particularly during spring. DMY of cows in the SHS was 27.8 ± 2.98 kg compared with 24.6 ± 2.77 kg in the FHS (Figure 2). The difference represented about

Table 3. LSM[1] ± SE of days open (DO) and number of services per conception (NSPC) of Holstein cows

Classification	NO.	DO		NSPC	
		$\overline{X}$ ± SE	P	$\overline{X}$ ± SE	P
Overall mean	693	147 ± 8.8		3.5 ± 0.25	
Housing system			NS		*
FHS	285	156 ± 7.2		3.9^{a} ± 0.20	
SHS	408	138 ± 10.4		3.1^{b} ± 0.29	
Parity			NS		NS
1	184	148 ± 8.0		3.8 ± 0.22	
2	255	153 ± 6.8		3.9 ± 0.19	
3	137	155 ± 7.9		3.5 ± 0.22	
4	91	150 ± 12.9		3.6 ± 0.36	
≥5	26	125 ± 22.6		2.5 ± 0.63	
Season of calving			**		NS
Winter	276	137^{a} ± 6.7		3.0 ± 0.19	
Spring	142	183^{a} ± 23.3		4.6 ± 0.65	
Summer	113	150^{a} ± 10.2		3.2 ± 0.28	
Autumn	162	116^{b} ± 7.1		3.1 ± 0.20	
Year of calving			**		**
2011	219	214^{a} ± 13.0		5.0^{a} ± 0.36	
2012	474	79^{b} ± 6.4		2.0^{b} ± 0.18	

[1]= Means within each classification have different letters are significantly different ($P<0.05$).
FHS and SHS are the first and the second housing systems, respectively. *= ($P < 0.05$), **= ($P < 0.01$) and NS= non-significant.

13%. In all seasons, cows in the SHS had shorter DO than those in the FHS. During autumn, this trait was in favours of the SHS by about 31% (100 ± 10.6 *vs.* 131 ± 8.1 days) (Figure 3). Cows in the SHS had always lower NSPC than those in the FHS during all seasons, except in summer where the values were exactly the same. In autumn, the difference was 1.5 services and was significant (Figure 4).

Better performance of cows in the SHS in all seasons could be attributed mainly to using advanced technologies and cooling system which alleviate heat stress on animals and improve their reproductive performance through providing a greater shading area and increasing the shed height to allow better ventilation.

Table 4. LSM[1] ± SE of productive and reproductive traits of Holstein cows as affected by housing system with season of calving interaction

Traits	Systems	No.	305-dMY	DMY	DO	NSPC
Winter (276)	FHS	122	8415^{ab} ± 263	26.8 ± 0.83	145^{b} ± 7.0	3.3^{bc} ± 0.2
	SHS	154	9270^{b} ± 382	29.4 ± 1.2	129^{b} ± 10.2	2.7^{ab} ± 0.28
	Difference		855	2.6	16	- 0.6
Spring (142)	FHS	53	7960^{ab} ± 881	24.6 ± 2.77	187^{b} ± 23.5	4.8^{c}± 0.66
	SHS	89	9025^{ab} ± 947	27.8 ± 2.98	179^{b} ± 25.3	4.4^{c} ± 0.7
	Difference		1065	3.2	- 8	0.4
Summer (113)	FHS	38	8200^{ab} ± 437	25.9 ± 1.37	157^{b} ± 11.7	3.2^{abc} ± 0.32
	SHS	75	8935^{ab} ± 522	28.3 ± 1.64	142^{b} ± 13.9	3.2^{abc} ± 0.39
	Difference		735	2.4	15	0.0
Autumn (162)	FHS	72	7900^{a} ± 304	24.8 ± 0.96	131^{b} ± 8.1	3.8^{c} ± 0.23
	SHS	90	8685^{ab} ± 397	27.6 ± 1.25	100^{a} ± 10.6	2.3^{a} ± 0.3
	Difference		785	2.8	31	1.5

[1]= Means within each column had different letters are significantly different (P<0.05).
FHS and SHS are the first and the second housing systems, respectively.
*= (P < 0.05), **= (P < 0.01) and NS= non-significant.

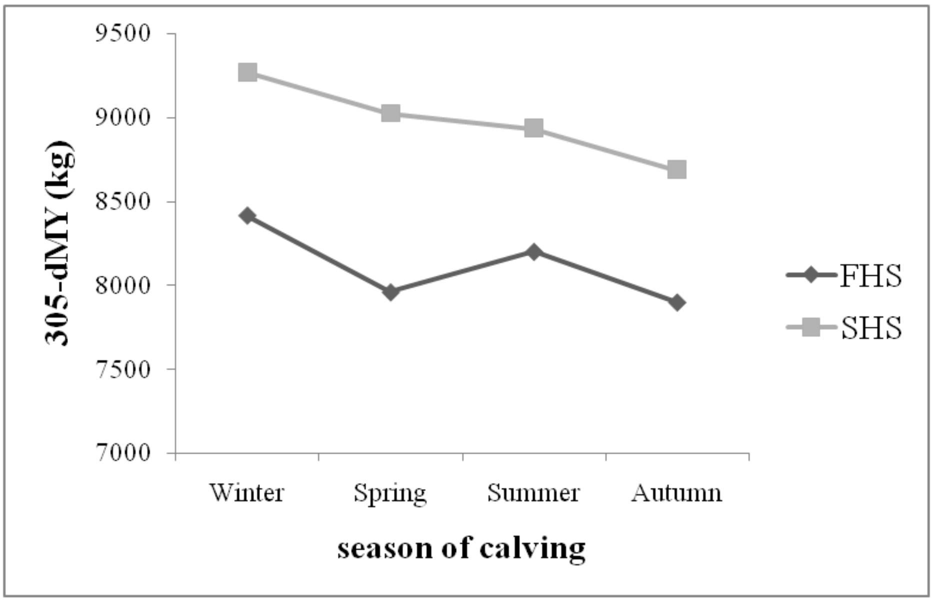

Fig. 1. Effect of housing system by season of calving interaction on 305-day milk yield (305-dMY)
FHS and SHS are the first and the second housing systems, respectively

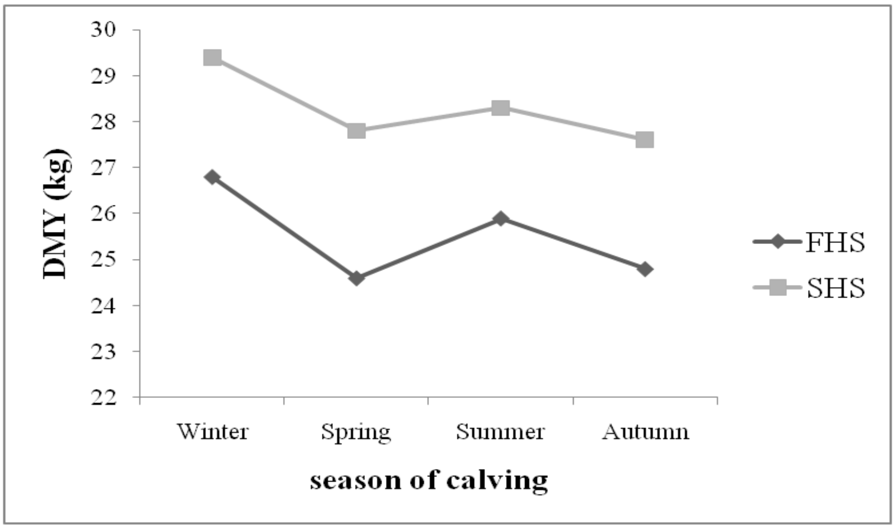

Fig. 2. Effect of housing system by season of calving interaction on daily milk yield (DMY)

FHS and SHS are the first and the second housing systems, respectively

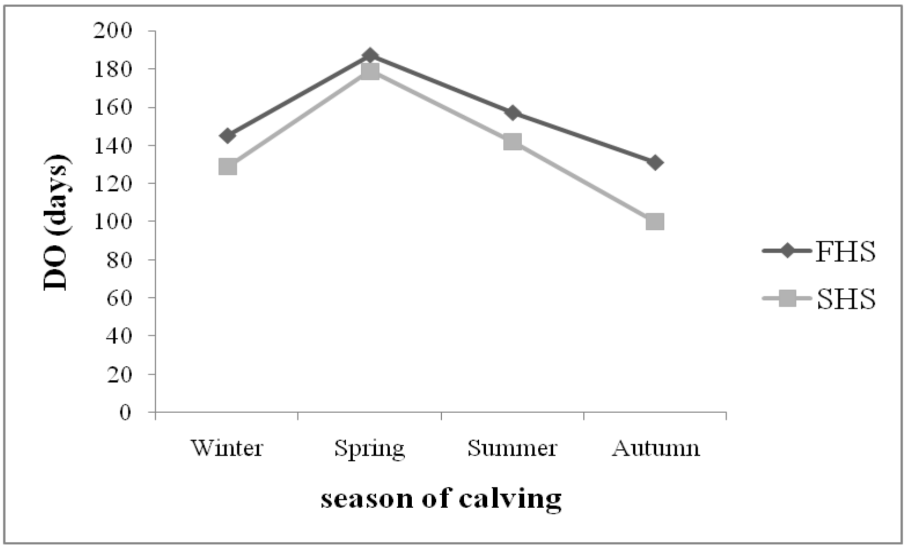

Fig. 3. Effect of housing system by season of calving interaction on days open (DO)

FHS and SHS are the first and the second housing systems, respectively

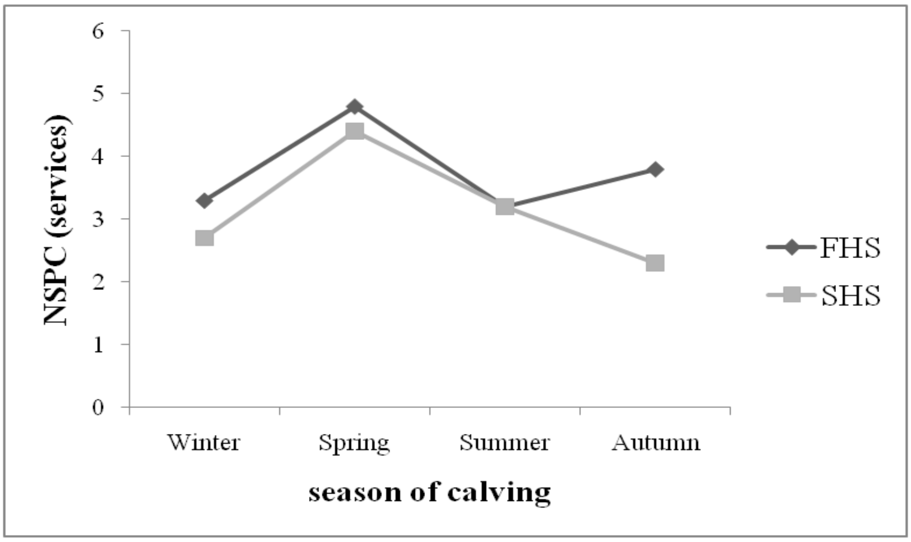

Fig. 4. Effect of housing system by season of calving interaction on number of services per conception (NSPC)

FHS and SHS are the first and the second housing systems, respectively

CONCLUSION

Housing system affect 305-dMY and DMY as well as DO and NSPC of Holstein cows in Egypt. Cows maintained under system having automatic cooling system, more shaded area and greater shed height produced more 305-dMY and DMY and required less NSPC and shorter DO.
It is recommended to carry out further studies with different environmental conditions, and also to conduct an economical evaluation of using the cooling systems.

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تأثير نظام الإيواء على الأداء الإنتاجي والتناسلي لأبقار الهولشتين في قطيع تجاري في مصر

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استخدم في الدراسة ٦٩٣ سجلاً لعدد ٦٩٣ بقرة هولشتين ربيت في مزرعة تجارية (مزرعة دينا) خلال الفترة من عام ٢٠١١ إلى عام ٢٠١٢، وكان الهدف الرئيسي من الدراسة هو تقييم ومقارنة بعض الصفات الإنتاجية والتناسلية لأبقار الهولشتاين تحت نظامي إيواء مختلفين. تميز نظام الإيواء الأول بوجود ست وحدات تبريد تعمل يدويا وكان ارتفاع المظلة ٤.٥ متراً و نسبة الظل ١٨ ٪ من مساحة الحظيرة . بينما تميز نظام الإيواء الثاني بوجود ١٦ وحدة تعمل أوتوماتيكياً مع ارتفاع ٨ متر للمظلة و نسبة الظل كانت ٣٨ ٪ من مساحة الحظيرة.

تم تجميع بيانات عن انتاج اللبن في ٣٠٥ يوم، إنتاج اللبن اليومي، الفترة المفتوحة وعدد التلقيحات اللازمة للإخصاب و تم تحليلها باستخدام برنامج XLSTAT. تم تقسيم السنة إلى أربعة فصول (الربيع، الصيف، الخريف والشتاء) وفقا للتقويم الجغرافي العالمي . تم حساب دليل الحرارة والرطوبة (THI) استنادا إلى البيانات التي تم جمعها من المعمل المركزي للمناخ الزراعي ، مركز البحوث الزراعية، وزارة الزراعة ، القاهرة، مصر .

كان المتوسط العام لصفات إنتاج اللبن في ٣٠٥ يوم، إنتاج اللبن اليومي، الفترة المفتوحة و عدد التلقيحات اللازمة لحدوث الإخصاب ٨٥٥٠±٣٣٠ كجم، ٢٦.٩ ± ١.٠٤ كجم، ١٤٧ ± ٨.٨ يوم و ٣.٥ ± ٠.٢٥ تلقيحة، على الترتيب، وكان الفرق بين نظامي الإيواء في كل الصفات المدروسة معنوياً ($P < 0.05$) لصالح نظام الإيواء الثاني ما عدا صفة الفترة المفتوحة حيث لم يصل الفرق للمعنوية.

تميزت أبقار النظام الثاني بارتفاع إنتاج اللبن في ٣٠٥ يوم (٨٩٨٠ ± ٣٩٠ كجم) بحوالي ١١% عنه في النظام الأول (٨١٢٠ ± ٢٦٩ كجم). وبالمثل تميزت أبقار النظام الثاني بارتفاع إنتاج اللبن اليومي (٢٨.٣ ± ١.٢٣ كجم) بحوالي ١١% عنه في النظام الأول (٢٥.٥ ± ٠.٨٤ كجم). علاوة على ذلك، كانت الفترة المفتوحة للأبقار تحت نظام الإيواء الثاني (١٣٨ ± ١٠.٤ يوم) أقصر من تلك في النظام الأول (١٥٦ ± ٧.٢ يوم). الأبقار المرباة في النظام الثاني كانت أقل في عدد التلقيحات اللازمة لحدوث الإخصاب من تلك المرباة في النظام الأول بنسبة ٢٦% (٣.١±٠.٢٩ مقابل ٣.٩ ± ٠.٢٠ تلقيحة).

خلال جميع فصول السنة، كانت الأبقار تحت نظام الإيواء الثاني أعلى في محصول اللبن في ٣٠٥ يوم و إنتاج اللبن اليومي وأقل في الفترة المفتوحة وعدد التلقيحات اللازمة للإخصاب من تلك التي تحت نظام الإيواء الأول . ويمكن أن تعزى هذه النتائج بشكل رئيسي إلى زيادة المساحة المظللة والارتفاع الأكبر للمظلات و نظام التبريد الفعال في نظام الإيواء الثاني ، والتي توفر ظروف مناخ أكثر راحة للحيوان.