COMPARATIVE STUDY AMONG DIFFERENT DAIRY PRODUCTION SYSTEMS IN EGYPT

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ABSTRACT: The present study was carried out between October 2014 and September 2015 to characterize and evaluate 297 different cattle and buffalo dairy production systems which represents the most distributed dairy systems in Egypt. The Systems included Commercial Systems (CS), Government commercial Systems (GS), Government Research Systems (GR), Traditional Landless system (TLL), Traditional mixed system (TMS) and Traditional intensive Systems (TIS).

Results showed that animal breeds had highly significant effect (P<0.001) on all productive traits. Least squares means ± SD of total milk yield were 10613± 2692 kg, 2715± 1697kg, 1844± 637kg, 1661± 714kg and 2603 ± 733kg for (CS), (GS), (GR), (TLL), (TMS) and (TIS), respectively. However, 4% fat corrected milk yield (FCM) reached the value of 10136.32± 2571.29, 2470.82 ± 1544.36, 2813.09 ± 862.32, 2712.45 ± 1270.82 and 2901.17± 853.08 kg for (CS), (GS), (GR), (TLL), (TMS) and (TIS), respectively.

Least squares means ± SD for average daily milk yield per head were 27.78 ± 5.53, 9.41 ± 3.74, 6.81 ± 2.02, 7.37 ± 2.68, 6.22 ± 2.49 kg and 11.30 ± 2.56 kg for (CS), (GS), (GR), (TLL), (TMS) and (TIS) respectively. The average of daily fat corrected milk per head were 26.14 ± 5.13, 8.55 ± 3.24, 10.37 ± 3.02, 10.31 ± 4.14, 10.79 ± 4.25 kg for the same systems, respectively. This associated with lactation length (LL) of 387.77 ± 98.39, 289.50 ± 140.76, 271.04 ± 92.21, 222.59 ± 36.22, 266.15 ± 30.96 and 230.12 ± 28.96 days, respectively.

Reproductive traits such as calving interval (CI), service period (SP) and numbers of services per conception (NSPC) showed highly significant differences among the different systems. Least squares means ± SD of (CI) for (CS), (GS), (GR), (TLL), (TMS) and (TIS) systems were 438.30 ± 112.766, 470.75 ± 113.434, 533.67 ± 91.896, 387.57 ± 56.293, 410.86 ± 62.202 and 423.75 ± 53.817 days, respectively. However, the least squares mean ± SD of (SP) were 163.12 ± 110.23, 107.72 ± 69.63, 155.50 ± 89.57, 117.57 ± 56.29, 140.86 ± 62.20 and 153.75 ± 53.82 days for the same systems, respectively. Furthermore least squares means ± SD of (NSPC) were 3.05 ± 2.52, 2.22 ± 1.30, 2.01 ± 0.48, 1.38 ± 0.68, 1.33 ± 0.57 and 1.65 ± 0.78 services (CS), (GS), (GR), (TLL), (TMS) and (TIS), respectively. All production systems showed imbalanced herd structure.

Key words: Dairy production systems, Buffalo, Cattle, Characterization, performance traits

INTRODUCTION

Agriculture is a key sector in the Egyptian economy, providing livelihoods for 55 % of the population and provides about 30 % of employing (FAO, 2012). Milk production plays an important role in the livelihoods of the people in Egypt and the need to expand milk production in Egypt is an urgent necessity due to the increase in population and the increase in the demand for dairy products year after year. Average annual milk production in Egypt is 5.28 million tons which increases annually by about 6.5% (Mohamed et al., 2008).
Livestock sector globally is highly dynamic. In developing countries, it is evolving in response to rapidly increasing demand for livestock products. In general livestock production systems can be considered as a complex system of organizational structures and processes. So far there is no accurate description of production systems in Egypt.

Most research indicates that milk production systems in Egypt are only two basic systems (industrial - traditional mixed). Abdel Aziz and Sadek (1999) and Tabana (2000) reported that there are two major systems of dairy production; the first system is the mixed traditional crop/livestock system and the second system is the industrial system (intensive, commercial farms). Abol Khair Sala (2012) reported that the two major milk production systems in Egypt are the traditional crop/livestock which holds about 96% of the cattle and buffalo population and the “industrial” intensive production system which contains large commercial farms.

In a general overview it is clear that there is multiple dairy production systems needed to clarify their productive and reproductive performance.

In Egypt, the problem statement is there is a shortage of information about traditional milk sector and its contribution to milk supply. Huge amount of milk is produced by smallholders through informal milk chain. Around 80% of the milk demand is provided by the traditional and informal sector (Census, 2010).

So, The present study was conducted to describe six different cattle and buffalo dairy production systems which represents the most distributed dairy systems in Egypt to understand the present dairy livestock production systems and to know in detail about these systems and its structure.

Information concerning dairy production systems may be useful to monitor the advantages and disadvantages of each system, consequently, it represents the more effective means by which animals adapt to various environmental factors and give us large view for the structure of dairy animal herds in Egypt.

MATERIALS AND METHODS
The data concerning productive and reproductive performance of six dairy production systems being maintained in Egypt were collected during the period between October 2014 and September 2015. Data collected included Commercial farms (CS), Government commercial (GC), Government research farm (GR), Traditional Landless system (TLL), Traditional mixed system (TMS) and Traditional intensive system (TIS). Land used production systems were randomly selected for interviewing the owners during “single visit monitoring”. In order to compare various production systems, milk production has been modified to 4% fat corrected milk (FCM). As a comparative criteria productive and reproductive performance (i.e. number of services per conception (NSPC), service period (SP), calving interval (CI), lactation length (LL), average daily milk yield (DMY) and total milk yield (TMY) were also studied.

Characterization of Dairy Production Systems
Commercial system (CS)
This system consists of 2000 heads of Holstein Friesian cattle including 850 dairy cows. Animals were housed free in shaded open yards, grouped according to their average daily milk yield and pregnancy status. Feeding was offered according to milk production and physiological status as recommended
Comparative study among different dairy production systems in Egypt

bye (NRC, 1989). Feeding offered in three equal meals daily at 8.00 a.m., 2.00 p.m. and 8.00 p.m. using Total Mixed Ration (TMR) technique. Clean water was available ad lib in build basin water.

Cows were inseminated artificially after 60 days post partum using frozen imported semen (Friesian Bulls).

Dairy cows were machine milked three times daily at 04.00h, 12.00h, and 17.00h by milking parlor. No food was offered during milking.

Government commercial system (GS)

This system consists of 150 head of Holstein Friesian cattle including 100 dairy cows. Animals were housed free in shaded open yards, grouped according to their average daily milk yield and pregnancy status.

Animals were fed on Berseem (Trifolium alexandrinum) from November to May and on Berseem hay and silage (Corn silage) from June to October. All over the year cows were also fed concentrate supplementary ration (containing at least 14 % - 16% crude protein and 65 % total digestible nutrient) and rice straw.

Feeding allowances were offered according to milk production and physiological status as recommended by NRC (1989). Clean water was available ad lib in built basin water and/or automatic drinkers. Feeding occurs according to the specific measure of dietary needs and which can be exchanged as follows: 1 kg of concentrates feed could be replaced with 6-8 kg Berseem (Trifolium alexandrinum), or 2 kg Berseem hay, or 3 kg silage (Corn silage), or 3 kg of rice straw.

Concentrate feed mixture were offered in two equal meals daily at 7.30 a.m. and 11.00 p.m. Rice straw offered once time daily at 9.00 a.m., while fresh Berseem or Berseem hay or corn silage were offered two times daily at 11 a.m. and 3.00 p.m.

In general, cows were inseminated artificially after 60 days post-partum using frozen imported semen (Friesian Bulls). In a few cases Holstein Friesian bulls were used for natural insemination with repeat estrus cows more than 3 times and no fertilization occurs. Dairy cows were milked twice daily at 04.00 a.m. and 18.00 p.m. except fresh cows and high yielding above 15 kg cows, they were milked three times daily at 04.00 a.m., 12.00 p.m., and 18.00 p.m. Dairy cows were machine milked by milking parlor. No food was offered during milking.

Government research system (GR)

It is a Government farm belonging to the Faculty of Agriculture, Menoufia University and consists of 29 dairy Buffaloes maintained for teaching, extension, and research purposes. The GR farm is comprised of multiple barns to accommodate animals of different ages and to facilitate different types of research. Most buffalos are housed in tie stalls to control and measure feed intake during research. The farm was managed according to Governmental economic rules. Animals were fed on Berseem (Trifolium alexandrinum) from November to May and on Berseem hay and silage (Corn silage) from June to October. All over the year buffaloes were also fed concentrate supplementary ration containing at least 14 % - 16% crude protein and 65 % total digestible nutrient and rice straw. Feeding allowances were offered according to milk production and physiological status. Clean water was available ad lib in automatic drinkers. Buffalo females were inseminated naturally after 60 days post-partum.

Dairy Buffaloes were machine milked twice daily at 05.00 a.m. and 04.00 p.m. by two unit Conveyor Milking machines.
Traditional system (TS)
Smallholders dairy farming is increasingly becoming an important source of livelihoods for small scale dwellers in Egypt. Data of two hundred and ninety-four (294) farms presents broad sector of breeders in Egypt situated in Menoufia province were investigated. This broad sector of traditional breeders and milk producers in Egypt could be divided into the following production systems:

Traditional Landless system (TLL)
Landless livestock systems refer to those systems where livestock are raised on a minimum area of land, generally on land that is not dedicated to the purpose of keeping livestock. This production system is defined by the use of ruminant species, principally cattle, where feed is mainly introduced from outside the farm. The data included 37 one barn farms with an average of 1.9 dairy animals (ranged from 1-4 head) maintained for milk production. Animals were fed according to available feed randomly and inseminated naturally during the second heats after post-partum. In some cases cows were artificially inseminated. Clean water was available in drinker's basins or drinking bucket for all animals in specific times on the day round.

Traditional mixed production system (TMS)
TMS is a mixed crop-livestock farming system consists of integrated crop and livestock activities. Livestock feeding in this system depend on green fodder produced from the field and crop residues. This farming system had little access to pasture and support services. The land size did not exceed 2 acres and a barn. This type of farming system does not cover all family living expenditure. The present study included 210 farms consists of local cows and buffaloes (occasionally cross cows) with an average of 1.62 dairy animal (ranged between 1-3 head). A majority of the farmers do not provide animals with concentrates and depend on natural grass only. Animals were fed on Berseem (Trifolium alexandrinum) from the first of October to May and on silage (Corn silage) from June to October. Wheat and/or rice straw were offered all year around. However feeding allowances were offered according to available feed.

Dairy animals were inseminated naturally within 12-15 hours after the detection of heat using selected bulls. In some cases cows were artificially inseminated (AI) in the case of the possibility of obtaining AI.

Cows were manually milked twice daily in the morning and evening time. Time of feeding has no exact pattern. Clean water was available in drinker's basins or drinking bucket for all animals in specific times on the day round.

Traditional intensive production system (TIS)
This farming system comprises farms with greater than 3 dairy animals. The data included 48 farmers. Farm consists of 3.89 dairy cattle in average ranged from 3 to 7 head maintained for milk production. They use high yielding local cows as well as some graded cows or cross-bred and buffaloes. The land size is 2.5 acres. Agricultural crops and their residues are used for feeding. Concentrated feed is relatively high in this system and a majority of the farmers provide concentrates beside straw feed. Animals were fed on Berseem (Trifolium alexandrinum) from first of October to May and on silage (Corn silage) from June to October and were also fed wheat straw or rice straw all year around. Feeding allowances were offered according to available feed.

Nutrition courses are offered at relatively regular times. Clean water was
available in drinker's basins or drinking bucket for all animals in specific times on the day round.

Data analysis
Data were statistically analyzed using Microsoft Excel 2007. Descriptive statistics such as means, standard deviation (SD) and percentages were generated by using the Statistical Package for Social Sciences (SPSS) software program version 20 (2015). The differences among the variables was analyzed using a one-way analysis of variance (ANOVA).

RESULTS AND DISCUSSION
Breeds and species distribution
As showing from Table (1) buffaloes represented the higher percentage of dairy animals in Traditional Systems (77-80% buffaloes and 20-23% cows). These results were in agreement with the finding of Soliman (2004) and Borghese (2005) who reported that dairy buffaloes in traditional small farm system shares by 60% of total milk production in Egypt. Pereira and Jayasuriy (2008) reported that buffaloes are the main dairy animal to the majority of smallholder farmers in many developing countries. Also, FAO (2012) and Radwan et al. (2016) reported that there was aggregate share of buffalo milk, from all types of production systems, reaches about 81% of total milk production in Egypt.

As shown in Table (2) and Figure (1) there are significant differences among productive traits of dairy cattle in different production systems.

<table>
<thead>
<tr>
<th>Items</th>
<th>(CS)</th>
<th>(GS)</th>
<th>(GR)</th>
<th>(TLL)</th>
<th>(TMS)</th>
<th>(TIS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species &amp; Breeds</td>
<td>Holstein Friesian cows</td>
<td>Buffaloes</td>
<td>Cross-bred (Balady X Friesian), Local cows and Buffaloes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Numbers</td>
<td>1245 cows</td>
<td>101 Buffaloes</td>
<td>14 cows + 47 buffaloes</td>
<td>63 cows + 231 buffaloes</td>
<td>32 cows + 130 buffaloes</td>
<td></td>
</tr>
<tr>
<td>% Cows</td>
<td>100%</td>
<td>0</td>
<td>23%</td>
<td>21%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>% Buffaloes</td>
<td>0</td>
<td>100%</td>
<td>77%</td>
<td>79%</td>
<td>80%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Breeds &amp; Species</th>
<th>TMY(kg/head)</th>
<th>DMY(kg/head)</th>
<th>LL(day/head)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holstein Friesian in (CS and GS)</td>
<td>7024.41 ±4554.52</td>
<td>20.78 ±10.19</td>
<td>347.63 ±126.54</td>
</tr>
<tr>
<td>Buffaloes in (GR)</td>
<td>1844.65 ±461.75</td>
<td>6.81 ±3.85</td>
<td>271.04 ±92.21</td>
</tr>
<tr>
<td>Buffaloes + Local cows +Cross bred cows in (TLL,TMS and TIS)</td>
<td>2761.47 ±312.36</td>
<td>10.97 ±2.13</td>
<td>254.83 ±24.70</td>
</tr>
</tbody>
</table>

**a, b, c:** Different superscript means significant differences among breeds (P<0.001)

** = Highly significant P< 0.001

TMY: Total Milk Yield ; DMY: Daily Milk Yield ; LL: Lactation Length
Holstein Friesian cows recorded 7024.41 ± 4554.52 kg for TMY with an average of 20.78 ± 10.19 kg for DMY which was associated with lactation length of 347.63 ± 126.54 days in two production systems (CS and GS). While systems raised Buffaloes only, such as GR, reached 1844.65 ± 461.75 kg for TMY with an average of 6.81 ± 3.85 kg for DMY which was associated with lactation length of 271.04±92.21 days. Dairy systems that raising Cross-bred, Local cows and Buffaloes such as in TLL, TMS and TIS all of them came in the middle where they recorded 2761.47 ± 312.36 kg for TMY with an average daily milk yield of 10.97 ± 2.13 kg which was associated with 254.83 ± 24.70 days lactation length.

Atallah et al. (2015) determined the effect of different dairy breeds on productive and reproductive traits. They indicated that the breed significantly affected (P<0.01) all studied productive and reproductive traits. Maler (2010) reported that the milk production in Egypt is less than the threshold of self-sufficiency because of low milk production of local breeds; exotic breeds are adopted to increase milk production in commercial herds where intensive systems were followed. Busato et al. (2000) pointed out that differences in udder conformation and milking characteristics between dairy breeds could be the reason of milk yield differences.

Herd productive traits
Total milk yield and fat corrected milk
The lactation performance of dairy cattle is usually measured by determining the total milk yield per lactation, average daily milk yield and lactation length. Milk yield is the most important single determinant of profit for the dairy cattle. Moreover, effects of lactation number, age, and season and year of calving on milk yield and lactation length are well known (Msanga et al., 2000 and Epaphras et al., 2004).

As shown in Table (3) least squares means ± SD of TMY were 10613.95 ± 2692.45 kg, 2715.19 ± 1697.09 kg, 1844.65 ± 565.45 kg, 1929.59± 637.79 kg, 1861.51± 714.71 kg and 2603.65 ± 733.48 kg for (CS), (GS), (GR), (TLL), (TMS) and (TIS), respectively.

Differences in milk fat percentage in different dairy breed led to different fat quantities. Therefore, milk yield was modified to become a 4% fat corrected milk (FCM). The results for FCM shown in Table (3) were 10136.32± 2571.29, 2470.82 ± 1544.36, 2813.09 ± 862.32, 2858.44± 1196.06, 2712.45 ± 1270.82 and 2901.17± 853.08 kg/head for (CS), (GS), (GR), (TLL), (TMS) and (TIS), respectively.
The results showed that there are highly significant differences in FCM (P<0.001) among different dairy production systems according to milk fat quantity differences.

Total milk yield of Holstein Friesian cows were reported by some researchers and ranged from 3210 ± 46 kg to 3977.75 ± 37.20 kg (Shalaby, 2001; Javed et al., 2011; Sattar et al., 2005; Amaniz et al., 2007 and Zahid et al., 2011). El-Awady (2012) indicated that the total milk yield was 5138 ± 742 kg, 8719 ± 839 kg and 13935 ± 808 kg for three Holstein Friesian herds in Egypt under intensive production systems.

On the other hand, results of TMY for dairy production systems raised buffalo breeds such as (GR), (TLL), and (TMS) were in agreement with estimates of El-Kirabi, (1995); Borghese, (2005); Mostafa, (2012) in Egypt who reported that buffalo productivity is 1200-2100 kg. While the global buffalo production was ranged by 1350 to 4500 liters in commercial per urban systems (Paisha, 2007 and FAO, 2016).

**Daily Milk Yield**

Least squares means ± SD of Daily Milk Yield (ADY) were 27.78 ± 5.53, 9.41 ± 3.74, 6.81 ± 2.02, 7.37 ± 2.68, 6.22 ± 2.49 and 11.30 ± 2.56 kg/ head for (CS), (GS), (GR), (TLL), (TMS) and (TIS) dairy systems, respectively. While, the average of 4% daily fat corrected milk were 26.14 ± 5.31, 8.55 ± 3.24, 10.37 ± 3.02, 10.31 ± 4.14, 10.79 ± 3.95 and 12.24 ± 4.25 kg/head, respectively (Table 4).

The results in Table (4) showed significant differences for daily milk yield among different dairy systems. Differences of DMY in both (CS) and (GS) systems was highly significant (P <0.001) where it was 27.78 kg/cow vs 9.41 kg/cow, respectively. Average of daily milk yield in (GS) was much lower than that expected for HF cows compared to the (CS) system, this may be due to poor management, lack of nutrition, lack of resources, low inputs and diseases which leads in general to low average milk production in (GS) where (CS) systems used breeding programs for genetic improvement and good management etc. These results came compatible with those of Khan et al. (2008) and Javed et al. (2011). In Egypt, some researchers reported higher estimated DMY such as El-Awady (2012);

### Table (3): Means ± SD for Total milk yield and fat corrected milk in different dairy production systems

<table>
<thead>
<tr>
<th>Dairy production systems</th>
<th>Number of dairy heads</th>
<th>Milk fat%</th>
<th>Total milk yield</th>
<th>Fat corrected Milk yield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Actual Milk yield (kg)</td>
<td>Fat corrected Milk yield (kg)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>CS</td>
<td>837</td>
<td>3.7</td>
<td>10613.95 ± 2692.45</td>
<td>10136.32 ± 2571.29</td>
</tr>
<tr>
<td>GS</td>
<td>408</td>
<td>3.4</td>
<td>2715.19 ± 1697.09</td>
<td>2470.82 ± 1544.36</td>
</tr>
<tr>
<td>GR</td>
<td>101</td>
<td>7.5</td>
<td>1844.65 ± 565.45</td>
<td>2813.09 ± 862.32</td>
</tr>
<tr>
<td>TLL</td>
<td>61</td>
<td>6.7</td>
<td>1929.59 ± 637.79</td>
<td>2858.44 ± 1196.06</td>
</tr>
<tr>
<td>TMS</td>
<td>294</td>
<td>6.7</td>
<td>1861.51 ± 614.59</td>
<td>2712.45 ± 1270.82</td>
</tr>
<tr>
<td>TIS</td>
<td>162</td>
<td>6.8</td>
<td>2603.65 ± 733.48</td>
<td>2901.17 ± 853.08</td>
</tr>
</tbody>
</table>

a, b, c, d Different superscript means significant differences among systems (P<0.001)
as 15.06 ± 0.27, 22.41 ± 0.78 and 26.32 ± 0.64 kg/head/day for three herds of HF cows, respectively. While, Kassab and Salem (2000) reported that the average DMY was 13.2 kg. Zaabal and Ahmed (2001) indicated that average daily milk production was 7.323±0.240 (kg / day) for HF cows.

Differences in average daily milk yield among (GR), (TLL) and (TMS) were not significant where it was 10.37± 3.02, 10.31± 4.14 and 10.79± 3.95 kg, respectively.

Buffaloes Daily milk yield estimated as more than of local cows by many researchers (Ahmed and Hassan, 2007; FAO, 2012 and Mostafa, 2012) they concluded that average daily milk yield of local cows was 5-8 and 3-5 kg/head for winter and summer seasons, respectively. The corresponding results of buffaloes are 10-12 and 7-9 kg/head, respectively in Egypt.

Lactation length

Lactation length (LL) was estimated to be as the period between two consecutive calving during which cows are capable of producing milk and / or lactating.

As shown in Table (5) Least squares means ± SD of (LL) were 387.77 ± 98.39, 289.50 ± 140.76, 271.04 ± 92.21, 222.59 ± 36.22, 266.15 ± 30.96 and 230.12 ± 28.96 days for (CS), (GS), (GR), (TLL), (TMS) and (TIS) dairy production systems respectively. Average of LL for (CS) was higher than (GS) systems. This difference between the two systems was highly significant (P<0.001) although both systems raised HF cows. This difference may be due to increase in the average of daily milk yield in (CS) system explained by differences in number of parities, age of cow, plane of nutrition, environmental and management system (Sattar et al., 2005). Poor feeding management of potentially high yielding cows can create many problems. Lactation in estrus can occur as the cows are forced to utilize more of their body reserves in early lactation. This can lead to low peak milk yields and shortened LL. As mentioned in the present results, Commercial system is the only system using the technique of Total Mixed Ration (TMR), which can consequently affect the nutritional efficiency of animals.

Table (4): Means ± SD of daily milk yield and fat corrected milk in different dairy production systems

<table>
<thead>
<tr>
<th>Dairy production systems</th>
<th>Dairy animals No.</th>
<th>Actual daily milk yield (kg)</th>
<th>Fat corrected daily milk yield (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Commercial system (CS)</td>
<td>837</td>
<td>27.78 ± 5.53</td>
<td>26.14 ± 5.13</td>
</tr>
<tr>
<td>Government commercial system (GS)</td>
<td>408</td>
<td>9.41 ± 3.74</td>
<td>8.55 ± 3.24</td>
</tr>
<tr>
<td>Government research system (GR)</td>
<td>101</td>
<td>6.81 ± 2.02</td>
<td>10.37 ± 3.02</td>
</tr>
<tr>
<td>Traditional Landless system (TLL)</td>
<td>61</td>
<td>7.37 ± 2.68</td>
<td>10.31 ± 4.14</td>
</tr>
<tr>
<td>Traditional mixed system (TMS)</td>
<td>294</td>
<td>6.22 ± 2.49</td>
<td>10.79 ± 3.95</td>
</tr>
<tr>
<td>Traditional intensive system (TIS)</td>
<td>162</td>
<td>11.30 ± 2.56</td>
<td>12.24 ± 4.25</td>
</tr>
</tbody>
</table>

a, b, c, d: Different superscript means significant differences among systems (P<0.001)
Comparative study among different dairy production systems in Egypt

Table (5): Means ± SD for Lactation length in different dairy production systems

<table>
<thead>
<tr>
<th>Dairy production systems</th>
<th>Dairy animals No.</th>
<th>Lactation length (days)</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial system (CS)</td>
<td>837</td>
<td>387.77a ± 98.39</td>
<td></td>
</tr>
<tr>
<td>Government commercial system (GS)</td>
<td>408</td>
<td>289.50b ± 140.76</td>
<td></td>
</tr>
<tr>
<td>Government research system (GR)</td>
<td>101</td>
<td>271.04c ± 92.21</td>
<td></td>
</tr>
<tr>
<td>Traditional Landless system (TLL)</td>
<td>61</td>
<td>222.59d ± 36.22</td>
<td></td>
</tr>
<tr>
<td>Traditional mixed system (TMS)</td>
<td>294</td>
<td>266.15c ± 30.96</td>
<td></td>
</tr>
<tr>
<td>Traditional intensive system (TIS)</td>
<td>162</td>
<td>230.12d ± 28.96</td>
<td></td>
</tr>
</tbody>
</table>

a, b, c: Different superscript means significant differences among systems (P<0.001)

Lactation length in (CS) system was higher than that of many researchers (Attil, 2000; Amaniz et al., 2007 and Atakan, 2011); they reported that LL was 300 days, 294.10 ± 3.62 days and 331.4 ± 6.92 days, respectively for HF cows. Irshad et al. (2011) documented average of LL of 320.14±11.14 days with range of 299.6±13.64 to 356.93±12.50 days. On the other hand, results of LL for (CS) were in agreement with finding of Usman et al. (2012) who reported that LL ranged from 185 to 514 days with mean of 366.5±76.71 days. While it was less than the average reported by Oliveria (1975) who found 392 ± 55.51 days for other herd of Holstein Friesian cow’s . Zahid et al. (2011) and Yousaf et al. (2011) reported that the maximum lactation length were 314.19 ± 0.91days and 311.19 ± 7.31 days, respectively.

Furthermore, the results for LL of (GR) system which raised buffaloes, and Traditional systems came in agreement with Mostafa (2012) who reported that buffalo lactation length was about 210-280 days. However Tonhati et al. (2004) reported that buffalo’s lactation length is around 250 days but shorter lactations are common.

The optimum LL in Murrah Buffalo has been reported by Jailton da Silva et al. (2014) as 262 to 295 days with average of 282.59 ± 39.48 days. All Paedia (2016) reported that LL in Egyptian buffaloes was 180-291 days.

Herd reproductive traits

Calving interval

Table (6) showed the least squares means ± SD of calving interval for (CS), (GS), (GR), (TLL), (TMS) and (TIS) systems, respectively being, 438.30 ± 112.77, 470.75 ± 113.43, 533.67 ± 91.89, 387.57 ± 56.29, 410.86 ± 62.20 and 423.75 ± 53.88 days, respectively.

These results showed that calving interval of all systems were longer than the optimum one which ranged from 387 to 533 day. There are many reports indicated that calving interval of 12 to 13.5 months is considered as standard values of Holstein Friesian cows (McDowell, 1985).

There are significant differences in CI among different production systems. The highest values for CI was in the GR being 533.67 days, followed by GS and CS. The Traditional system, especially the TMS, had the lowest value of CI being 387.57 days.
Table (6): Least squares means ± SD of calving interval; Service periods and Numbers of services per conception in different dairy production systems

<table>
<thead>
<tr>
<th>Dairy production systems</th>
<th>No.</th>
<th>Calving Interval (days)</th>
<th>Service Periods (days)</th>
<th>Numbers of Services per Conception</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>(CS) 837</td>
<td></td>
<td>438.30 ± 112.77</td>
<td>163.12 ± 110.23</td>
<td>3.05 ± 2.52</td>
</tr>
<tr>
<td>(GS) 408</td>
<td></td>
<td>470.75 ± 113.43</td>
<td>107.72 ± 69.63</td>
<td>2.22 ± 1.30</td>
</tr>
<tr>
<td>(GR) 101</td>
<td></td>
<td>533.67 ± 91.89</td>
<td>155.50 ± 89.57</td>
<td>2.01 ± 0.48</td>
</tr>
<tr>
<td>(TLL) 61</td>
<td></td>
<td>387.57 ± 56.29</td>
<td>117.57 ± 56.29</td>
<td>1.38 ± 0.68</td>
</tr>
<tr>
<td>(TMS) 294</td>
<td></td>
<td>410.86 ± 62.20</td>
<td>140.86 ± 62.20</td>
<td>1.33 ± 0.57</td>
</tr>
<tr>
<td>(TIS) 162</td>
<td></td>
<td>423.75 ± 53.88</td>
<td>153.75 ± 53.82</td>
<td>1.65 ± 0.78</td>
</tr>
</tbody>
</table>

Average calving interval for (CS) and (GS) systems where HF cows were raised was longer than the optimum one. This may be due to the differences in the number of parities, age of cow, plane of nutrition, environmental and management system (Sattar et al., 2005).

In Egypt, Marizok (1998) reported that calving interval for locally-born Friesian cows and was 426 days. El-Sadafy (1989) and Zaabal and Ahmed (2001) reported that the calving interval was 423 and 398.050 ± 2.429 days for Holstein Friesian cows respectively.

Higher estimated calving interval of Holstein Friesian cows was reported by Sattar et al. (2005) and El Awady (2012) accounting for 505.02 ± 8.28 days and 635.0 ± 8.6, respectively.

On the other hand, results of calving interval for production systems which raised buffaloes such as Government research system (GR) was longer than the optimum one, but Traditional systems came in line with the finding of Barkawi et al. (1998) in Egyptian buffaloes who reported that buffalo's calving interval was ranged from 400.3 to 441.5 days. Ahmad et al. (2001) reported that buffalo calving interval ranged from 506.6 to 570.6 days.

**Service period**

Services period is the time taken from calving to next successful insemination (Khan, 2008). Table (6) showed the least squares means ± SD of service period (SP) for (CS), (GS), (GR), (TLL), (TMS) and (TIS) systems, respectively systems which were 163.12 ± 110.23, 107.72 ± 69.63, 155.50 ± 89.57, 117.57 ± 56.29, 140.86 ± 62.20, 153.75 ± 53.82 days, respectively.

Service periods for six systems under study ranged from 107 to 163 days; it's longer than the optimum one, which the standard length of service periods is 60 days (USDA, 2014).

There are significant differences (P<0.001) in SP among different production systems. However there were no significant differences in SP among CS, GR, TIS and TMS systems, being 163.12, 155.50, 153.75 and 140.86 days, respectively. GS and TLL had the lowest values of SP being, 107.72 and 117.57 days, respectively. Higher estimate of (SP) reported with (CS) being 163.12±110.32 days, while (GS) had the...
Comparative study among different dairy production systems in Egypt

lowest service period being, 107.72 ± 69.63 days although both systems raised Holstein Friesian cows. These differences may be due to that the commercial system has the largest productivity systems of total milk yield and daily milk yield which are inversely associated with fertility. Tadesse et al. (2010) and Zahid et al. (2011) documented that the average of service period was 129.95 ±2.14 days with a range of 121.23±2.14 days to 136.92±2.33 days in Holstein Friesian cows. However Kassab and Salem (2000) reported a higher average value for service period (171.2 days).

Results of service period for production systems raised buffaloes such as (GR) and Traditional systems were less than many global estimated values such that reported by Javed et al. (2011) who found that SP was 249±15.36 days and Quereshi et al. (1999) who reported that least squares mean for SP was 162.0 days and ranged between 67.2-220.5 days. On other hand lower estimates of SP ranged from 70.3 to 98.0 days was reported by Arya and Madan (2001).

Number of services per conception

Table (6) showed the least squares means ± SD of numbers of services per conception (NSPC) for (CS), (GS), (GR), (TLL), (TMS) and (TIS) being, 3.05 ± 2.52, 2.22 ± 1.30, 2.01 ± 0.48, 1.38 ± 0.68, 1.33 ± 0.57, 1.65 ± 0.78 services respectively.

As shown in Table 6 the NSPC were higher in some systems than the optimum one and varied between 1.3 and 3.0. However many reports indicated that the NSPC of 1.3 to 1.5 services are considered as standard values (McDowell, 1985). Zahid et al. (2011) reported that the NSPC was 2.8 services. In Egypt, El Awady, (2012) reported that (NSPC) were ranged from 1.53±0.04 to 3.44±0.09 services.

On the other hand Zaabal and Ahmed (2008) estimated lower value of (NSPC) as (1.30±0.146) in HF cows in Egypt. Javed et al. (2011) reported that the least squares mean of (NSPC) was 1.99 ± 0.13 services, however, the maximum and minimum least squares mean of the (NSPC) were 2.29 ± 0.33 and 1.21 ± 0.24 services, respectively. Goshu et al. (2007) and Tadesse et al. (2010) reported that the overall mean for (NSPC) was 1.720 ± 0.056 and 1.80 ±1.00 services, respectively in Holstein Friesian cows.

Furthermore results of (NSPC) for production systems which raised buffaloes such as GR system and Traditional systems were less than many global estimates. Kotby et al. (1987) reported that least squares mean for (NSPC) was 1.87± 0.07 services from 344 buffaloes at 2 farms. Javed et al. (2011); Ahmed et al. (2001) and Quereshi et al. (1999) reported that least squares means for (NSPC) were 1.99 ± 0.13, 2.15 ± 0.04 and 2.0 services, respectively. On the other hand , lower estimate of (NSPC) in buffaloes reported by Shafique and Usman (1996) it was 1.30 ± 0.01 services.

Furthermore there are significant differences in the (NSPC) between the CS and GS systems (P>0.005), while the differences are not significant between the GS and GR systems. The differences among the three Traditional systems were also non-significant.

The number of services per conception depends largely on the breeding system used and were significantly affected by lactation length and milk yield (Quereshi et al., 1999). However Mukasa-Mugered (1989) reported that (NSPC) depends largely on the breeding system used and are higher
under uncontrolled natural breeding and lower where hand-mating or artificial insemination is used.

Herd structure
Table (7) showed that commercial systems have 41.3% of cows exist in the first parity, followed by second parity (22.6%) , third parity (15.8%) and fourth parity (14.1%) respectively , then a significant decline in number occurred in the fifth parity (3.2%) that explains the administration’s policy of push the largest number of heifers in the first parity and then pick the best ones for the third parity of the largest productive seasons.

The same distribution exists in GS system, which have more than 47.7% of cows in the first parity, followed by second parity (20.0%), third parity (11.2%) and fourth parity (8.1%), while a significant decline in number occurred in the fifth parity (5.6%). Also GR system have more than (28.4%) of the cows exist in first parity, followed by second parity (23.5%) and third parity (16.7%) and fourth parity (12.7%), while a significant decline in number occurred the fifth parity (4.9%) with 13.7% of animals celebrating the fifth season. Traditional production systems have also shown varying proportions of dairy herd components ranged between 10-30.0% and 5.9-29.4% for cows and buffaloes respectively raised in TLL, TMS and TIS.

Dairy herd structure influences the overall herd performance and the ability to maintain constant output from the herd. Herd performance varies considerably according to parity, if herd parity changes over a period of time, production variation will be increased and immunity will be affected. The ideal situation is where there is a steady flow of replacement heifer into the herd and a good spread of females across the parity range (Patrick et al., 2015).

A number of cows in a dairy herd will be culled each year for reasons of low milk yield, infertility, disease, old age, etc. These cows are best replaced with young stock from their own herd, since any animals acquired from outside the farm may bring disease to the herd (El Kaschab, 1998).

In general, all production systems showed a non-typical herd structure and this does not allow for a good herd replacement.

<table>
<thead>
<tr>
<th>Lactation No. (parity)</th>
<th>Production systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(CS)</td>
</tr>
<tr>
<td></td>
<td>(GS)</td>
</tr>
<tr>
<td></td>
<td>(GR)</td>
</tr>
<tr>
<td></td>
<td>(TLL)</td>
</tr>
<tr>
<td></td>
<td>(TMS)</td>
</tr>
<tr>
<td></td>
<td>(TIS)</td>
</tr>
<tr>
<td>HF cows</td>
<td>HF cows</td>
</tr>
<tr>
<td>Buffaloes cows</td>
<td>Buffaloes</td>
</tr>
<tr>
<td>cows</td>
<td>cows</td>
</tr>
<tr>
<td></td>
<td>Buffaloes cows</td>
</tr>
<tr>
<td></td>
<td>cows</td>
</tr>
<tr>
<td></td>
<td>Buffaloes</td>
</tr>
<tr>
<td>1</td>
<td>41.3% 47.7% 28.4% 20.0% 8.8% 28.6% 20.5% 29.2% 15.2%</td>
</tr>
<tr>
<td>2</td>
<td>22.6% 20.0% 23.5% 30.0% 29.4% 24.5% 18.5% 20.8% 19.6%</td>
</tr>
<tr>
<td>3</td>
<td>15.8% 11.2% 16.7% 30.0% 35.3% 22.4% 20.0% 20.8% 28.3%</td>
</tr>
<tr>
<td>4</td>
<td>14.1% 8.1% 12.7% 10.0% 8.8% 14.3% 9.2% 16.7% 26.1%</td>
</tr>
<tr>
<td>5</td>
<td>3.2% 5.6% 4.9% 10.0% 11.8% 10.2% 15.4% 12.5% 10.9%</td>
</tr>
<tr>
<td>5≥</td>
<td>3.0% 7.3% 13.7% 0.0% 5.9% 0.0% 16.4% 0.0% 0.0%</td>
</tr>
<tr>
<td>Total No., of dairy animals</td>
<td>837 408 101 14 47 63 231 32 130</td>
</tr>
</tbody>
</table>
Figure (2): Illustration of dairy herd structure within different production systems

Commercial system showed that structure difference between the first lactation and the fifth lactation is about 38% (Table 7). Also GS system showed that the differences about 40%. On the other hand GR system and Traditional system showed structure difference of about 25%. Stewart (2015) reported that the difference in age structures must be considered when making comparisons among herds. For this reason, it is usual in some countries, notably the USA, to convert all milk yields to mature equivalents before calculating herd averages. The difference between a first lactation and a mature lactation is about 25% in most herds, so the conversion will make a significant difference. El Kaschab (1998) reported that cows are commonly culled after three to five lactations, corresponding to a replacement rate of 20 to 30% per year. However, John Hibma (2010) reported that the average annual culling per replacement rate for the same dairy herds is around 30% almost one-third of the milking herd. Whether a dairy is milking 100 cows or 1,000 cows, herd replacement expenses represent a significant cost of doing business. The annual culling rate among herds ranged from 34 to 36% (Sol et al., 1984 and Smith et al., 2000). The average replacement rate on UK dairy farms is 30% but there is variation between farms among 11% and 62% in a recent survey (Julia, 2017).

The percentage of dairy cows within the third parity is very low compared with the percentage of dairy cows in the first parity in Commercial System (41.3% vs. 15.8%), Government Commercial System (47.7% vs. 11.2%) and GR system (28.4% vs. 16.7%) (Table 7). Traditional systems showed a larger percentage of dairy animals in the third parity compared to the first one (30.0% cows and 35.3% buffaloes vs. 20.0% cows and 8.8% buffaloes for TLL; 28.6% cows and 20.5% buffaloes vs. 22.4% cows and 20.0% buffaloes for TMS and 20.8% cows and 28.3% buffaloes vs. 29.2% cows and 15.2% buffaloes for TIS (Table 7). However many researches confirm that the third parity has the highest milk production. Lateef et al. (2008) reported that milk yield of HF cows was higher in second and third than fourth and fifth parities and the effect of parity on milk yield was highly significant (P<0.001).
General Discussion and conclusion

The objective of this study was to characterize the most distributed diary production systems in Egypt according to production elements.

The results about production characterization in different production systems revealed that some breeders prefer to combine buffaloes and cows in one production system such as in Traditional systems. The aim of these breeders was to produce the appropriate milk for community needs surrounding the farm.

There are significant differences among productive traits in different dairy production systems. These differences confirm that the production systems are different in animal breeds, feeding systems, breeding systems and management systems, in addition to the different purpose and the main objective of the production which could be affect milk produced cost within each system.

It is noted in the present study that the average of reproductive traits were higher than the optimum one, which led to losses in the production system and increase production costs. On-farm reproductive management could be identifying the problem cows, which can be effectively treated. Missing one estrus extends the calving interval in cows and the age at first calving in heifers by about 21 days which could be in turn resulting in economic losses. Length of calving interval or service period leads to reduced annual milk production, high feeding costs, problems in the replacement and higher levels of involuntary replacement of the herd, and the farm is forced to sell animals at a low price. The main findings of the present study are that farmers miss estrus in a high percentage of cows. On-farm reproductive management could be identifying the problem cows, which can be effectively treated.

All production systems studied did not have balanced herd structure which could be affecting the replacement rate in the herd and all milk production levels. This will affect the cost of milk production within each system.

Finally, it can be concluded that all Traditional milk production systems and Government production systems needs only an appropriate decision maker who can improve production using the available production elements.

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دراسة مقارنة بين أنظمة إنتاج الألبان المختلفة في مصر

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قسم الإنتاج الحيواني، كلية الزراعة، جامعة المنوفية، مصر

الملخص:

أجريت هذه الدراسة لوصف 297 نظام انتاج الألبان من الأبقار والجاموس في الفترة من أكتوبر 2014 وحتى
سبتمبر 2015 وتم قسم ستة أنظمة إنتاج الألبان تمثل أفرع أنظمة إنتاج الألبان في مصر وهي: نظام المزارع التجاري (GR)، نظام المزارع الحكومي (GS)، نظام المزارع التقليدية (TMS)، نظام المزارع الرعوية (TLL)، نظام المزارع التقليدية المختلطة (TIS).

أظهرت النتائج أن أنظمة إنتاج الألبان المختلفة تختلف في الدفعة الفصلية ومتوسط العام (P > 0.001) على جميع الصفات الإنتاجية. المتوسط العام ± الانحراف المعياري لإنتاج الألبان الكلي على أنظمة إنتاج الألبان المختلفة:

- TMS: 337 ± 79.6
- TIS: 28.07 ± 12.6
- TLL: 23.26 ± 8.6
- GS: 29.62 ± 12.3
- GR: 33.1 ± 7.2

ارتباط هذه الدراسة بطول مسح النباتات وظائفه الرياحية، وعند تغذية الألبان في أنظمة إنتاج الألبان المختلفة، تختلف بين أنظمة إنتاج الألبان المختلفة بنحو 6%.

نظام المزارع الرعوية (TLL) على أنظمة إنتاج الألبان المختلفة:

- تأثير شامل (TMS): 337 ± 79.6
- TIS: 28.07 ± 12.6
- TLL: 23.26 ± 8.6
- GS: 29.62 ± 12.3
- GR: 33.1 ± 7.2

أظهرت أن أنظمة إنتاج الألبان المختلفة تختلف في الدفعة الفصلية ومتوسط العام على أنظمة إنتاج الألبان المختلفة.

كما أظهرت أن أنظمة إنتاج الألبان المختلفة تختلف في الدفعة الفصلية ومتوسط العام على أنظمة إنتاج الألبان المختلفة.

تظهر أن أنظمة إنتاج الألبان المختلفة تختلف في الدفعة الفصلية ومتوسط العام على أنظمة إنتاج الألبان المختلفة.

الكلمات المفتاحية: أنظمة إنتاج الألبان، التوصيف، النباتات المساهمة في النباتات المساهمة.