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Influence of Age on Ingestive Behaviour, Suckling Disorders, Productive Traits, Milk Constituent and Serum Cortisol Level of Friesian Dairy Cows

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Ingestive Behaviour, Suckling Disorders, cow

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ABSTRACT

This study was carried out during the period from February 2016 to February 2017 on 100 Friesian dairy cows aged (3-7 years old) of different parities belonged to private dairy farm which locate at Hehia city at Sharkiya governorate. The aim of the present study was to investigate the effect of age of dairy cows on their ingestive behaviour, suckling disorders, productive performance, milk constituents and serum cortisol level of Friesian dairy cows. The results were revealed that, on ingestive behaviour, the age of 4th years old was the highest significant (P<0.05) feeding time, feed frequency, drinking time, drinking frequency, rumination time and rumination frequency (399.9 min, 87.2, 18.6 min, 142.9, 52.2 min and 37.2); respectively. The mutual suckling time and frequency were at highest significant level (P<0.05) at early life of age (three years), while the tongue rolling, ear and nose suckling were increased with age. On productive traits at different ages studied, the 7 years old age group was the highest significant (P<0.05) at parity (4.66). Meanwhile, the 6 years old age group was the highest significant (P<0.05) at milk production and day in milk (8077.5 kg and 300.0 day; respectively). Dry period showed non significant results between the different ages. The 6th years of age was the highest significant (P<0.05) cortisol level (2.80 ng/mL) than other ages. Correlations between productive and ingestive behaviour traits for all ages studied showed positive high significant estimates (P<0.05) at parity with drinking frequency, milk production with day in milk , feeding time with drinking frequency and feeding time with rumination time. Concerning the effect of age on the milk components, the SNF and protein components of the milk were significantly lower (P<0.05) in young than adult cows (from 3 years to 7 years), however, significant difference was not observed in fat, lactose and pH of the milk between age groups.

1. INTRODUCTION

Raising dairy cows is very important aspect of whole farm management that can be characterized by a long-duration of production and high-cost period (Zanton and Heinrichs, 2005). Ingestive behaviour of dairy cattle is influencing by the age of cattle, as it can affect animal welfare, but also their productivity and thus, production economy. The relationships between feed intake behaviour and feed characteristics can be used for improvement animal productivity (Forbes, 2007).

Ingestive behaviour of dairy cows is an important factor of many components of grazing systems. Time spent by animals in grazing activities such as grazing, rumination and resting reflects in climatic and pasture (availability and quality) conditions and physiological states of animals, and thus relate to the performance of animals

(Higashiyama and Hirata, 1995 and Hasegawa and Hidari, 2001).

The use of modern housing systems needs cattle resistant to stress and have the ability to cope the environment with new procedures of dairy husbandry management as automat zed feeding and milking (Debreceni et al., 2009). The farm animals should be kept in harmony with their physiological and safety needs and should manifest the maintenance behaviour (Kottferova et al., 2008).

Functional traits have received increasing attention in breeding programs for dairy cattle in many countries. Functional longevity is a trait of particular interest for the breeders; it reflects fertility, health, and overall fitness of cow, not the level of cow's production. The relationship between longevity and animal health and integrity makes longevity a highly desirable trait in dairy production. (Vukasinovic et al., 1997, 2001). The age of animal is one from different factors may influence the composition of milk (Lindmark-Mansson et al., 2000). Information about variation of milk composition in relation to age of cattle is scant.

In general, many factors besides nutrition and management can influence milk yield and composition. This is an important point to remember when evaluating the milk quality and in the improvement of milk yield and composition (Jemila and Achenef 2012). A lineal effect of age at first calving on dairy lactation in Holstein cows was determined. A reduction of age at first calving leads to a depletion of milk production, probably affecting the genetic potential of the animal, and its longevity within the herd. Further studies are required to prove this hypothesis. (Salazar-Carranza et al., 2014). Therefore, this research aimed to investigate the effect of age of dairy cows on their ingestive behaviour, suckling disorders, productive performance, milk constituents and serum cortisol level of Friesian dairy Cows.

2. MATERIAL AND METHODS

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

2.1. Animals and General Management

This study was carried out on 100 Friesian dairy cows (3-7 years old) of different parities belonged to private dairy farm which locate at Hehia city at Sharkiya governorate from the period of 1st February 2016 till the end of February 2017 to investigate the effect of age of dairy cows on their ingestive behavior, productive performance and some milk constituents. Animals in all groups were fed as the policy of the farm. The cows were provided with a total mixed ration as the recommendation of NRC (2001). Dairy cows provided with clean water ad-libitum from a common permanent water trough located in the yard. Well ventilated, constructed herring bone automatic milking parlour was available with capacity of 24 cow/ cycle. The parlour was provided with electronic digital display, recording the milky cows number, also milk production of each cow. All data are collected and recorded automatically on a central computer powered by digital system which is a specialized system for dairy farm's electronic data management, to be analyzed later to detect the milk yield for each cow. Udder management and teat dipping was done according to Whist et al., 2006). Cows weren't subjected to identical dry period but it was estimated according to their days in milk, stage of pregnancy and milk yield by decrease the number of milking from three to one daily, then milk day after day, non stripping of all udder and remain milk in udder and decrease the production ration (Najafi et al., 2009). All cows were marked by applying an ear tag which contain number and the same number was applied on sides chest of each animal by using a colored paint materials

2.2. Experimental design

One hundred of apparently healthy Friesian dairy cow aged from (3-7 years old) of different parities was kept in loose housing in partially sheltered yards. The animal were distributed into 5 yards (20 animal / yard), 10 animals were selected from each yard to estimate the effect of age of animal on grazing behaviour. The shelters represented 70% of the yard at 5 cm in height with dusty floor. Two concrete mangers were located in the yard (1 m/cow) water sprinklers were provided during summer season to maintain the body temperature of animal (Shibata, 1996). Group 1: dairy cows in this group were aged 3 years. Group 2: dairy cows in this group were aged 4 years. Group 3: dairy cows in this group were aged 5 years. Group 4: dairy cows in this group were aged 6 years. Group 5: dairy cows in this group were aged 7 years.

2.3. Behavioural observation:

The method of observation was done by using a focal sample technique as recommended by Youssef (1995). A stop watch, field notice and photographing camera were used. The grazing behaviour of the cows for each group were recorded during 12 hr observation per month as it represented the day light hours (6 minute interval for each cows through one hour observation).

DATA MEASUREMENTS

2.4. I.BEHAVIOURAL PERFORMANCE

The method of observation was done by using a focal sample technique as recommended by **Youssef (1995)**. A stop watch, field notice and photographing camera were used. The grazing behaviour of the cows for each group was recorded during 12 hr observation per month as it represented the day light hours (6 minute interval for each cows through one hour observation). All behavioral traits were recorded as time and frequency.

Trait Time: The mean time (min) spent in trait per (12 h) observation.

Trait frequency: The mean number spent in trait per (12 h) observation.

a. Ingestive behavior: (Eating-Drinking-Rumination) (Phillips, 2002).

b. Suckling disorders:

1. Mutual suckling: is an abnormal behaviour in dairy cows, and it is defined by one animal sucking the teat of another animal with the intention of sucking milk (Lidfors, 2003).
2. Tongue rolling frequency.
3. Ear, nose manager licking frequency.

2.4. II. PRODUCTIVE TRAITS: (Najafi, 2009).

a. Number of birth for each cow (parity).
b. Total actual milk production (kg).
c. Days in milk (days).
d. Dry period (days).

2.4. III. Milk constituents by chemical examination: (www.Milkotester.com)

Chemical examination was done by ultrasonic portable milk analyzer (milkotester model- Master Mini) for:

a. Determination of fat %.
b. Determination of protein %.
c. Determination of lactose %.
d. Determination of solid not fat (SNF) %.

Milk samples should be 5-35˚C and mixed well before examination. Pouring it several times out of one vessel into another and back. The pH was measured at the time of testing by direct insertion of the electrode (pH meter, Adwa kft, AD11, Romania) into well mixed samples.

III. STRESS INDICATING HORMONE (Cortisol hormone level):

-Blood sampling:

The blood samples were collected randomly from 15 dairy cows (three of each group) one time monthly for 3 months (experimental period) according to their age at mornning to overcome the circadian variation in hormone levels (Saleem, 1995 & Bertoni *et al.*, 2002). The samples were obtained from jugular vein puncture at the end of the neck base of females and were allowed to coagulate at room temperature for 30 minutes, and centrifuge at 3000 r.p.m for 10 minutes. The clean, clear sera were aspirated carefully by pasture pipette and were transfered into dry and sterile labeled tube then were kept at a deep freezer at -20 ^{o} c till the analysis. Cortisol level was estimated by using corticosterone commercial kits (Fukasawa *et al.*, 2008).

2.4. IV. STATISTICAL ANALYSIS:

Data were statistically analyzed using (SPSS, 2013) (version 22) according to the following model: Yijk = μ + Ti+ eij, where, μ is the overall mean, Ti is the fixed effect of different ages groups and eij is random error. One Way ANOVA test was used for comparison to obtain least squares means and were tested for significant differences using Duncan's Multiple Range Test (Duncun, 1955). All data were expressed as the least square mean (LSM)±S.E. $p<0.05$ was considered to be statistically significant.

3. RESULTS AND DISCUSSION

Concerning the ingestive behaviour at different ages studied as showed in Table (1) the four years old age group was the highest age at feeding time, feed frequency, drinking time, drinking frequency, rumination time and rumination frequency (399.9 min, 87.2, 18.6 min, 142.9, 52.2 min and 37.2) respectively and the differences were significant. These results were in agreement with results recorded with (Munksgaard and Jensen, 1996); (Broucek et al. , 2013) as they suggested the feeding and rumination behaviour were increased with advanced age. As well as, (Bae et al., 1983); (McDonald et al., 2002) and

(Forbes, 2007) as they stated that feed intake increases with the growth of the cattle.

In contrast, Rustas et al. (2009) found in ingestive time, including both eating and ruminating was very little affected by the age. Although, Baumont et al. (2006) as they mentioned that the ingestive behavior didn't affected by the age of cattle. The obtained results in table (2) showed that the mutual suckling time and frequency between the dairy females according to their age were at highest level at early life of age (three years, 9416.0 ± 60.08 ^{a}) and four years, 223.33±17.27 ^{b}) and gradually were disappeared at seven years of age and the differences were significant. These results were similar to that obtained with (Keil,2001); (Lidfors ,2003) and (Jensen, 2003) as they suggested that cattle sucking the udder of cows, is a frequent problem in dairy herds and may lead to udder damage, mastitis, milk loss in cows is. The continuation of this habit was already occurred in a cow's sub adult life and more frequently at primiparous than multiparous dairy cow so is importance of looking not only at the animal's current environmental situation but also considering its entire life history for the prevention of this behavioural problems.

As well as, Mahmoud, et al (2016) mentioned that milk sucking was higher in primiparous than multiparous cows during the second lactation period, as primiparous cows start to suck mostly around the 4th month of milking. Mastitis and elongation of the front teats were observed in sucker cows. The use of pronged nose-rings was effective in preventing milk sucking and all cows were must culled at the end of the season. The results in this paper suggested that the tongue rolling, ear and nose suckling were increased with age , these results were in disagreement with (Karatzias et al., 1995) and (Mahmoud et al., 2016) as they stated that tongue rolling in dairy cows due to manganese deficiency and not affected by the age and also, ear suckling occurred in calves at the 2nd week of age followed by abscesses at ears. Licking of the manager was decreased with advanced age. These results were similar to Jensen (2003); (Webb etal., 2015) and (De Vliegher et al., 2012) as they suggested that non-nutritive sucking of another body is detrimental behaviour seen in artificially reared calves. Although, they stated that cross-sucking may also be stimulated by hunger and the influence of milk allowance, as well as distribution of milk meals.

Table 1. Effect of age on ingestive behaviour of Friesian dairy cow.

Behaviour	Three years of age	Four years of age	Five years of age	Six years of age	Seven years of age
Feeding time	178.5^{c} ±3.06	399.9^{a}± 8.96	346.0^{b} ± 10.90	296.0^{c} ± 5.62	238.5^{d} ±9.92
Feeding frequency	60.8^{c} ± 2.30	87.2^{a} ±3.19	80.7^{ab} ±3.35	75.8^{b} ±3.23	66.1^{c} ±3.79
Drinking time	10.3^{d} ±1.01	18.6^{a} ±0.70	15.8^{b} ±0.84	12.8^{c} ±0.74	10.3^{d} ±0.47
Drinking frequency	91.7^{c} ±1.67	142.9^{a} ±2.41	142.2^{a} ±2.76	137.1^{a} ±1.37	125.0^{b} ±2.45
Rumination time	30.9^{c} ±1.12	52.2^{a} ±4.91	42.8^{ab} ±3.76	50.6^{a} ±3.81	39.2^{bc} ±3.25
Rumination frequency	31.1^{c} ±2.02	37.2^{a} ±1.76	33.5^{ab} ±2.07	32.7^{ab} ±1.99	35.3^{ab} ±1.70

Means of different ages within the same row having different superscripts are significantly different (p = 0.05).

Table 2. Effect of age on some suckling disorders of Friesian dairy cow

Age / Disorders	Three years of age	four years of age	five years of age	six years of age	seven years of age
Mutual suckling time	416.0^{a}±60.08	223.33^{b} ±17.2	13.0^{c} ±3.61	0.0^{c} ±0.0	0.0^{c} ±0.0
Mutual suckling frequency	5.0^{a} ±0.58	5.33^{a} ±1.45	2.0^{b} ±0.58	0.0^{b} ±0.0	0.0^{b} ±0.0
Tonque rolling frequency	1.33^{d} ±0.33	2.67^{cd} ±0.20	10.33^{ab} ±1.7	7.33^{bc} ±1.7	14.33^{a}±2.33
Ear suckling frequency	3.0^{a} ±0.58	2.67^{a} ±0.20	3.33^{a} ±0.88	2.0^{a} ±0.58	4.67^{a} ±0.88
Manager licking frequency	13.0^{a} ±0.58	9.67^{ab} ±1.45	5.33^{c} ±1.45	6.67^{bc}±0.8	5.67^{c} ±0.88
Nose licking frequency	1.33^{c} ±0.88	2.0^{bc} ±0.58	9.0^{a} ±1.53	5.33^{b}±0.88	3.0^{bc} ±0.15

Means of different ages within the same row having different superscripts are significantly different (p ≤ 0.05).

Table 3. Effect of age on productive traits of Friesian dairy cow.

Traits	Three years of age	Four years of age	Five years of age	Six years of age	Seven years of age
Parity	2.00^{d} ±0.0	2.14^{d}±0.05	3.11^{c} ±0.11	4.00^{b} ±0.4	4.66^{a} ±0.33
Total milk production (kg)	5406.4^{bc} ±298.47	7761.22^{a} ±256.10	6814.44^{ab} ±457.25	8077.5^{a} ±1018.52	4406.67^{c} ±697.05
Day in milk	202.36^{b} ±7.78	283.8^{a} ±10.02	239.83^{ab} ±9.21	300.0^{a} ±75.32	189.0^{b} ±22.05
Dry period	52.52^{a} ±1.07	52.69^{a} ±0.71	53.11^{a} ±1.36	56.00^{a} ±1.29	51.67^{a} ±1.45
Cortisol ng/mL	0.40^{c} ±0.12	2.31^{a} ±0.17	1.25^{b} ±0.05	2.80^{a} ±0.31	0.73^{bc}±0.24

Means of different ages within the same row having different superscripts are significantly different ($p \leq 0.05$).

Table 4. Correlation between productive and grazing behaviour traits for all ages studied of Friesian dairy cow.

	Parity	Milk production	Day in milk	Dry period	Feeding time	Feed frequency	Drinking time	Drinking frequency	Rumination time	Rumination frequency
Parity	-	-0.184	-0.199*	-0.031	0.318	0.227	-0.101	0.498**	0.213	-0.071
Milk production	-0.184	-	0.746**	0.053	0.291	0.236	0.290	0.282	0.001	-0.006
Day in milk	-0.199*	0.746**	-	0.089	0.258	0.217	0.255	0.191	-0.110	0.013
Dry period	-0.031	0.053	0.089	-	.027	.020	0.121	0.098	0.010	-0.166
Feeding time	0.318	0.291	0.258	0.027	-	0.629**	0.694**	0.820**	0.436**	0.159
Feed frequency	0.227	0.236	0.217	0.020	0.629**	-	0.589**	0.566**	0.486**	0.167
Drinking time	-0.101	0.290	0.255	0.121	0.694**	0.589**	-	0.553**	0.446**	0.278
Drinking frequency	0.498**	0.282	0.191	0.098	0.820**	0.566**	0.553**	-	0.521**	0.189
Rumination time	0.213	0.001	-0.110	0.010	0.436**	0.486**	0.446**	0.521**	-	0.236
Rumination frequency	-0.071	-0.006	0.013	-0.166	0.159	0.167	0.278	0.189	0.236	-

*. Correlation is significant at the 0.05 level. **. Correlation is significant at the 0.01 level.

Table 5. Effect of age on some milk components of Friesian dairy cow

Traits	Three years of age	Four years of age	Five years of age	Six years of age	Seven years of age
Fat%	3.61^{a} ±0.95	3.73^{a}±1.05	3.85^{a} ±1.08	4.05^{a} ±1.12	4.10^{a} ±1.33
Protein %	3.17^{a} ±0.41	3.23^{b}±0.44	3.25^{c} ±0.48	3.30^{d} ±0.52	3.34^{e} ±0.53
Lactose %	4.71^{a} ±0.24	4.76^{a}±0.25	4.85^{a} ±0.22	4.95^{a} ±0.32	5.00^{a} ±0.33
SNF %	8.61^{a} ±0.25	8.65^{b}±0.35	8.67^{c} ±0.30	8.71^{d} ±0.32	8.75^{e} ±0.33
pH	6.58^{a}±0.05	6.60^{a}±0.05	6.63^{a} ±0.04	6.65^{a} ±0.02	6.65^{a} ±0.03

Means of different ages within the same row having different superscripts are significantly different ($p \leq 0.05$).

Regarding to productive traits at different ages studied, the 7 years old age group was the highest significant at parity (4.66). Meanwhile, the 6 years old age group was the highest significant at milk production and day in milk (8077.5 kg and 300.0 day; respectively). Dry period showed non significant results between the different ages. The 6 years old age group was the highest significant at cortisol level (2.80 ng/mL) (Table 3). This agreed with results recorded by Zavadilová and Štípková (2103) who that there is a lower probability to show conceive for cows in class over 33 months of AFC. This disagreed with results recorded by Gurmessa and Melaku (2012) and Pratap et al. (2014) who found that milk yield did not show significant variation in different age and parity groups and this may be due to the fact that the farm of their study was established only two years ago that cows are fairly young and calving was not much. But,

on our study different ages represented and occurred complete development of mammary gland tissues by successive parturition. This disagreed with results recorded by Vera et al. (2011) who found that heifers had greater cortisol concentrations than 2-year-old cows.

(Table 4) showed that there were correlations between productive and ingestive behaviour traits for all ages studied, showed positive high significant estimates at parity with drinking frequency, milk production with day in milk, feeding time with feed frequency, feeding time with drinking time, feeding time with drinking frequency, feeding time with rumination time, feeding frequency with drinking time, feeding frequency with drinking frequency, feeding frequency with rumination time, drinking time with drinking frequency, drinking time with rumination time and drinking frequency with rumination time (0.498, 0.746, 0.629, 0.694, 0.820, 0.436, 0.589, 0.566, 0.486, 0.553, 0.446 and 0.521; respectively). These results mean that any improvement of one trait leads to improve the other due to presence of significant correlation between them.

There were a positive correlation coefficient between eating (time &frequency), productive performance and rumination (time& frequency) and the differences were highly significant. These obtained results were in agreement with that obtained with (Mertens, 1997) as they mentioned that there were a direct relation ship between eating ,rumination time and milk production . There was a negative correlation coefficient between drinking time and parity of female. There was a negative correlation coefficient between rumination time and day in milk of female. There was a negative correlation coefficient between rumination frequency and parity, total milk production any dry period of female and positive correlation with other ingestive behaviour parameters (Hutjens, 2008). In contrast (Borges, 2012) found that there was no level of significance between milk production and rumination time.

In (table 5) the protein and SNF components of the milk were significantly lower ($P<0.05$) in young than adult cows (from 3 years to 7 years), however, significant difference was not observed in fat, lactose and pH of the milk between age groups. These results were in agreement with Gurmessa and Melaku (2012) and Pratap et al. (2014).

CONCLUSION

From this study it could be suggested that the ingestive behavior, suckling disorders, productive performance and milk constituents of female dairy buffaloes were changed according to their age. The feeding and rumination behavior were increased with advanced age although, the age of 4th years old was the highest age on ingestive behaviour. The mutual suckling time and frequency were at highest level at early life of age. The productive performance (milk production and day in milk) were at highest level at the 6th years old of age. The protein and SNF components of the milk were increased with advanced age (from 3 years to 7 years), however, significant difference was not observed in fat, lactose and pH of the milk between age groups.

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