



## **INFLUENCES OF ROUGHAGES TYPE, CONCENTRATE LEVEL AND STAGE OF LACTATION ON BEHAVIOR; MILK YIELD AND COMPOSITION OF DAIRY COWS**

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### **ABSTRACT:**

Thirty dairy cows were housed in a loose-housing yard in six groups of 5 cows each, where the first 3 groups were fed 50% and the others were fed 70% concentrates. Within each concentrate level roughages fed were Barseem hay and/or Ammoniated straw rice. Cows were milked 2 times /day by milking machine. Milk samples were collected in small cups and transferred to chemical analysis. Milk yield was recorded daily. Focal sample behavioral observation was carried out by observer during the day time. The analyzed data revealed that:

- 1-Increasing the level of concentrate in ration reduced feeding time, drinking time, rumination time, standing time, walking frequency and exploratory activities. On contrary increased lying time, standing idle time grooming and butting frequencies.
  - 2-Feeding ammoniated straw rice reduced feeding time, rumination time, lying time, while, increased standing time and standing idle time.
  - 3-Cows during mid lactation periods spent longer feeding time, rumination time, and standing time, while, they spent short time lying and grooming activities.
  - 4-Late lactation period was associated with short drinking time, standing time and low grooming, exploratory and butting frequencies, they while, spent longer time lying.
  - 5-Increase level of concentrates in ration increased milk yield, protein% while, reduced fat, lactose, total solid and solid not fat percentages.
  - 6-Types of roughages in ration did not show obvious changes in the milk yield or composition.
  - 7-Cows in mid lactation period secreted more milk but with low fat, protein, lactose total solid and solid not fat percentages.
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### **INTRODUCTION:**

Dairy cows divide their feeding time into a series of meals separated by non-feeding intervals. The intersection point between within-meal and between-meal distributions defines the meal criterion for dairy cattle (*Keyserlingk et al.,*

*2004*). Moreover, they are herbivores and in the natural habitat they usually exhibit daily rhythm of maintenance behavior. Factors such as space availability, social dominance and feeding regime influenced feed intake and milk yield (*Olofesson, 2000*). Furthermore aspects

like feeding has an impact on the rumen environment, where less frequent feeding has a negative influence (*Le Liboux and Peyroud, 1999*) and increased feeding frequency increases milk yield (*Gibson, 1984*).

Generally cows are fed concentrate during milking to improve milk let down and milking management. Feeding during milking has a positive influence on milking characteristics and behaviors such as social interactions, standing and rumination (*Johansson et al., 1999*). Moreover, they can both create and respond to heterogeneity in vegetation (*Adler et al., 2001*). There is a substantial effort in studying how animals respond to heterogeneity once it is present (*Dumont et al., 2002*). Roughages heterogeneity is important as it will affect subsequent utilization by animals which may in-turn affect patterns of nutrient return (*Morris, 2000*).

The objective of this study was to evaluate the effect of feeding Barseem hay and/or ammoniated rice straw within two levels of concentrates on behavioral patterns; milk yield and composition of dairy cows within different stages of lactation.

## **MATERIALS AND METHODS:**

### **Animals:**

Thirty Friesian cows were selected for the study as focal sample from a herd belonging to Private dairy farm, Kafer El-Sheikh province. The cows were between lactations first and fifth. 12 cows were in early lactation (weeks 3–13), 12 in mid lactation (weeks 18–21) and 6 in late lactation (weeks 28–33). They were allotted into 6 groups (n=5) even distribution of the cows within each group was considered according to their body weights, age and stage of lactation.

The animals were identified by numbers painted on their barrel and rump for visual observation.

### **Housing and management:**

Thirty cows were housed in a loose-housing yard divided into six groups (n=5). The yard was provided with a shed and surrounded by metal pipe fences, while the floor was earthy floor. Feeding of cows was carried out according to the following regimes:

G1: 50% concentrate and 50% Barseem hay.

G2: 50% concentrate, 25% Barseem hay and 25% ammoniated rice straw

G3: 50% concentrate and 50% ammoniated rice straw.

G4: 70% concentrate and 30% Barseem hay.

G5: 70% concentrate, 15% Barseem hay and 15% ammoniated rice straw

G6: 70% concentrate and 30% ammoniated rice straw.

Water was supplied through common water trough at the middle of the yards. Mineral blocks were provided in front of the animal as a source of minerals.

The cows were milked 2 times/day by milking machine. Before milking udder was subjected to washing by the use of warm water. After washing, udder was dried by using damp cloth then cups were applied to teats until cessation of milk flow. Milk samples were collected in small cups contains preservative till chemical analysis with recording daily milk yield of each cow.

### **Behavioral observation:**

A staggered 14 hour study on maintenance behavior was recorded in an ethogram from 06:00 a.m. to 20:00 p.m. This was done so as to include the morning and evening milking. Observations on maintenance behavior of the cows were made every 5 min by trained

observer. No observations were made for individual focal animals from the time they left the group for milking until they returned back to the group. The observation was done according to *Martin and Frs (1986)*, focal behavioral observation was carried out.

### Statistical analysis:

Data were analyzed by analysis of variance with concentrate level, roughage type and stage of lactation as independent variables. When differences among concentrate level, roughage type and stage of lactation were significant, means were separated using Duncan's multiple range test (*SAS, 2001*).

## RESULTS:

### Ingestive behavior:

The data presented in table (1) showed that adding hay and rice straw mixture in required longer feeding and drinking time either with a ration contains 50% concentrates ( $27.73 \pm 1.54$  and  $4.07 \pm 0.51$  min/h) or contains 70% concentrates ( $16.32 \pm 1.49$  and  $4.07 \pm 0.62$  min/h) than hay alone ( $21.57 \pm 1.54$  and  $2.79 \pm 0.39$  vs.  $16.14 \pm 1.33$  and  $3.64 \pm 0.53$  min/h, respectively) or rice straw alone ( $23.50 \pm 1.58$  and  $3.71 \pm 0.41$  vs.  $15.93 \pm 1.42$  and  $2.57 \pm 0.46$  min/h, respectively). Moreover, time spent feeding and drinking were shorter in cows fed 70% concentrates ( $16.13 \pm 1.41$  and  $3.43 \pm 0.54$  min/h, respectively) than those fed 50% concentrates ( $24.27 \pm 1.56$  and  $3.52 \pm 0.44$  min/h, respectively).

Feeding hay required longer rumination time either 50% or 70% concentrates rations ( $9.68 \pm 1.00$  and  $7.89 \pm 0.81$  min/h, respectively) than ammoniated rice straw ( $7.55 \pm 0.82$  and  $6.68 \pm 0.78$ , respectively). Moreover, reducing roughages in the ration and increasing concentrates reduced significantly rumination

time ( $8.36 \pm 0.91$  vs.  $6.68 \pm 0.77$  min/h for 50 and 70% concentrates, respectively).

Cows in mid lactation exhibited significantly longer feeding and rumination time ( $24.82 \pm 2.18$  and  $9.49 \pm 1.29$  min/h) than those in early lactation ( $18.08 \pm 1.33$  and  $6.85 \pm 0.71$  min/h, respectively) or late lactation ( $22.93 \pm 3.28$  and  $8.23 \pm 2.31$  min/h, respectively).

### Resting behavior and Movement activities:

Data presented in Table (1) showed that ingestion of 50% hay with 50% concentrates increased time spent by cows in lying while, reduced time spent standing and standing idle ( $10.25 \pm 1.32$ ,  $49.75 \pm 1.32$  and  $20.54 \pm 1.24$  min/h, respectively), also when fed with 70% concentrates ( $10.63 \pm 1.36$ ,  $49.38 \pm 1.36$  and  $29.46 \pm 1.26$  min/h, respectively). The shortest lying time and longest standing and standing idle were for cows fed ammoniated rice straw ( $6.18 \pm 1.03$ ,  $53.82 \pm 1.03$  and  $31.32 \pm 1.50$  min/h, respectively). On the other hand, increasing concentrates in ration resulted in longer time spent lying and standing idle ( $8.93 \pm 1.21$  and  $30.2 \pm 1.43$  vs.  $7.49 \pm 1.05$  and  $22.3 \pm 1.22$  min/h, respectively) and shortest active standing time with less frequent walking ( $51.07 \pm 1.21$  min/h and  $17.29 \pm 1.60$  time/h, respectively), although however, the type of roughages in the ration did not show a distinct trend (Table 1).

Cows in late lactation exhibited significantly longer lying time and frequent walking activity ( $11.53 \pm 3.63$  min/h and  $23.60 \pm 4.17$  time/h, respectively), while, they exhibited the shortest standing time active or idle ( $48.47 \pm 3.63$  and  $19.30 \pm 2.67$  min/h, respectively). On contrary, cows during mid lactation exhibited shortest lying time and longest active standing time.

### Body care, exploration and social activities:

The total grooming activity and total exploratory behaviors and butting frequencies are presented in Table (1). Type of roughages in ration did not show a distinct trend although however, mixed roughages in the ration reduced these activities, while, feeding 70% concentrates and 30% roughages increased grooming activities and decreased exploring activities than 50% concentrates with 50% roughages ( $8.93 \pm 1.28$  and  $0.57 \pm 0.55$  vs.  $7.43 \pm 0.98$  and  $0.93 \pm 0.32$  time/h, respectively).

Early lactating cows exhibited more frequent grooming and exploration activities ( $8.30 \pm 1.06$  and  $1.42 \pm 0.45$  time/h, respectively), which declined gradually to reach the lowest frequency during late lactation period ( $7.60 \pm 2.03$  and  $0.80 \pm 0.56$  time/h, respectively).

### Milk yield and composition:

The increment of concentrates level to 70% in the ration increased the milk yield, protein% and somatic cell counts of dairy cows, Table 2 ( $7.88 \pm 1.10$ ,  $2.74 \pm 0.08$  and  $331.00 \pm 67.81$ ) than 50% concentrates ( $6.33 \pm 0.27$ ,  $2.47 \pm 0.10$  and  $203.50 \pm 22.73$ , respectively). However, it resulted in lower level of fat% ( $3.12 \pm 0.17$  vs.  $3.39 \pm 0.20$ ); lactose% ( $4.07 \pm 0.14$  vs.  $4.19 \pm 0.09$ ); total solid% ( $9.88 \pm 0.16$  vs.  $10.50 \pm 0.11$ ) and solid not fat% ( $6.76 \pm 0.08$  vs.  $7.11 \pm 0.14$ ).

The types of roughages in ration did not show a pronounced effect on the milk yield or composition where mixed roughages with 50% concentrates yield low amount of milk while, cows that fed hay with 70% gave much milk (Table 2). With respect to fat content cows fed mixed roughages produced higher fat% than others groups.

Dairy cows during mid lactation gave much amount of milk than those at early or late lactation ( $7.33 \pm 0.43$  vs.  $6.87 \pm 0.65$  and  $5.78 \pm 0.45$ , respectively), with lowest fat ( $3.10 \pm 0.14$  vs.

$3.26 \pm 0.31$  and  $3.41 \pm 0.10$ ) and total solid percentages ( $10.28 \pm 0.08$ ). On contrary, the cows in late lactation gave milk of high fat ( $3.41 \pm 0.10$ ), protein ( $2.56 \pm 0.13$ ), total solid ( $10.645 \pm 0.20$ ) and solid not fat percentages ( $7.25 \pm 0.11$ ). The increment of somatic cell count was obvious in cows just after parturition ( $239.73 \pm 39.20 \times 1000$ ) than those in mid lactation ( $219.50 \pm 26.14 \times 1000$ ) or in late lactation ( $208.00 \pm 33.65 \times 1000$ ). While, the solid not fat% increased from after parturition till late lactation ( $6.91 \pm 0.11$ ,  $7.17 \pm 0.12$  and  $7.25 \pm 0.11$ , respectively).

### DISCUSSION:

Even small changes such as reduced in-parlour feeding caused poor milk ejection and a drop in milk yield in Buffaloes. Buffaloes seem to be sensitive to the slightest change in milking routines, which was immediately reflected in the milk yield, moreover, maintenance behavior affected by increased access to roughage through out the day which could influence milk ejection. (Thomas *et al.* 2005). Here we are going to discuss the influences of ration composition and stage of lactation on the behavior, milk yield and milk composition of dairy cows.

### Ingestive behavior:

Mixing hay and rice straw required longer feeding and drinking time either with than hay or ammoniated rice straw alone. Moreover, time spent feeding and drinking were shorter in cows fed 70% concentrates than those fed 50% concentrates. Differences in the eating pattern were observed in the bouts of eating behavior, which were more evenly distributed as a consequence of increased access to roughage. Thus, care should be taken to provide roughage ad libitum to satisfy the natural eating behavior of cows. Increment of concentrates in ration reduce the amount of food to be ingested and so

reduce feeding time, similarly, *Penning et al., (1993)* and *Varlyakov and Trufchev (1993)* who reported that the increase crude fiber level, increase feeding time and *Tyler et al., (1997)* who observed that when cows have access to feed after milking they remain longer standing with feeding.

Rumination of hay time either with 50% or 70% concentrates required longer time than ammoniated rice straw. Moreover, reducing roughages in the ration reduced significantly rumination time. This could be attributed to the chemical treatment of rice straw which may improve the quality of the fibers and encourage the microflora and microflora of the rumen for microbial digestion and so reduced time required for rumination. While, dryness of hay reduce its water content so that increased time of ingestion and rumination. Similar trend observed to rice straw without ammonia treatment. These results are in close accordance with *Teller et al. (1991)* who found that dry matter needs more rumination time, while, feeding concentrate needs less rumination time and the increase crude fiber level, increase feeding time *Penning et al., (1993)* and *Varlyakov and Trufchev (1993)*.

Mid lactation cows exhibited significantly longer feeding and rumination time than those in early lactation or late lactation, which could be attributed to development of the fetus during this period in pregnant cows which needs more nutrient while, during early lactation the requirements becomes less than during this period moreover, during late lactation, although the nutritional requirement increased however, the cows eat less due to the pressure of the fetus on the rumen. Similar results were obtained by *Thomas et al. (2005)*.

**Resting behavior and Movement activities:**

Since the increase of the level of concentrates reduces the need for movement so, animals spent most of their time in standing idle ruminating their ingested feed or doing nothing, we reported that cows fed ration contains 50% hay and 50% concentrates spent longer time in lying while, reduced standing and standing idle, also when cows fed 70% concentrates. The shortest lying time and longest standing and standing idle were for cows fed ammoniated rice straw. Moreover, increasing concentrates in ration prolonged time spent lying and standing idle and shortest active standing time with reducing frequency of walking. This could be attributed to small volume of concentrate ingested as compared to roughages so when concentrates increase in ration this come on expense of much amount of roughage and so feeding time which accompanied by shorter standing time and longer lying time. Similar results obtained by *Edwards et al. (1993)* who found that cows fed high roughage feed, spent longer time feeding and shorter time resting and *Olofsson (2000)*, who reported that reduced access to roughage and competition for feed, cattle spend longer time standing.

A recent study in dairy cattle reported that animal in late lactation rested more often than those in early stages of lactation (*Chaplin and Munksgaard, 2001*). Similarly, we observed that cows in late lactation exhibited significantly longer lying time and frequent walking activity, while, they exhibited the shortest standing time active or idle. On contrary, cows during mid lactation exhibited shortest lying time and longest active standing time, which could be attributed to increased load, applied on the limbs of the animal due to increased body weight and relaxation of the body ligaments for preparation for parturition and so increment the inclement of cows to lying down.

### **Body care, exploration and social activities:**

Differences in the grooming activity (licking, foot scratching and body friction) due to different types of roughages was not obvious while, due to concentrate levels was obvious where higher concentrate level (70%) was accompanied by longer time spent lying in these groups, which associated with lower exploratory activities. This finding is in agreement with that noticed by Teller *et al.* (1991) and Edwards *et al.* (1993). Moreover, Varlyakov and Trufchev (1993) stated that cows become curious to explore its environment just after stocking then decline after adaptation period where environment becomes familiar to them.

Cows during early lactation period exhibited more frequent grooming and exploration activities, which declined gradually to reach the lowest frequency during late lactation period Table (1). This could be attributed to the increase in body weight of pregnant animal during this period which accompanied by reducing activities such as body care activities and exploratory activities becomes in the second priority after feeding and drinking while, the animals spent longer periods in resting during late lactation (Chaplin and Munksgaard, 2001)

### **Milk yield and composition:**

As milk yield considered as an end product of good management, good health and genetic structure of the animal which could be inhibited by any disturbance or change in this chain (Bruckmaier and Blum 1996) the increment of concentrates to 70% in ration increased milk yield, protein% and somatic cell counts of dairy cows than 50% concentrates Table(2). However, it resulted in lower level of fat, lactose; total solid and solid not fat percentages, although however, roughages type in ration did not show

a pronounced effect on the milk yield or composition.

Generally, cows are fed concentrate during milking to improve milk letdown and milking management. Feeding during milking has a positive influence on milk characteristics and yield (Johansson *et al.*, 1999). This may be a result of a more pronounced milking related oxytocin secretion (Thomas *et al.*, 2005). However, cows are sensitive to small changes in milking routines, with effects on the milk yield (Pathak, 1992), whereby it is not excluded that minor changes, such the amount of concentrate fed during milking, could have an impact on milk let down and thereby milk yield characteristics. These results supported the results observed in our study which showed concentrate level and roughage type in ration affected behavior, milk yield and milk composition of dairy cows Table (1) and Table (2).

The increment of the milk secretion during mid lactation is expected as the development of secretory cells reach the peak during such stage then decline again till drying off. Moreover, the increase in milk secretion affect more or less the composition of milk such as fat which decreased with the milk yield. While, somatic cell increased directly after parturition because subclinical mastitis conditions which become pronounced with the commencement of milk yield however, with treatment it decreased during mid and late lactation (Thomas *et al.*, 2005).

From our study it could be concluded that treating rice straw with ammonia improve the palatability of the rice straw and so improve its digestion moreover, increasing concentrates level in ration increase milk yield especially during the mid lactation stage.



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## تأثير نوع المواد المائنه ومستوى المركزات ومرحلة الإدرار على سلوكيات إدرار اللبن ومكوناته في الأبقار الحلابة

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تعتبر التغذية من أهم المعاملات التي تتم داخل المزرعة وتتكلف أكثر من 50% من مجمل تكلفه المزرعة حيث أنها تؤثر تأثيراً مباشراً على صحة الحيوان ونتاجيته، ولقد أجريت هذه الدراسة لتقييم استعمال القش بعد معاملته بالأمونيا مقارنة بالدريس، وكذلك رفع مستوى المركزات في العليقة في تحسين مذاق القش، وبالتالي رفع الكفاءة الإنتاجية للحيوان حيث أجريت هذه الدراسة على ثلاثين بقرة حلابة تم تسكينها في ياردات قسمت إلى ست مجموعات حيث تم تغذية ثلاث مجموعات على عليقه تحتوى على 50% مركزات والثلاث الأخرى تم تغذيتها على عليقه بها 70%. قسمت المجموعات الثلاث (داخل كل مستوى من المركزات) على أساس نوع المواد المائنه أما دريس برسيم ، برسيم وقش أو قش معاملاً بالأمونيا. تم استخدام الحليب الألى للحيوانات مرتين يومياً ، وتم تسجيل كميته اللبن لكل حيوان وأخذت عينات للتحليل الكيمياءى بالإضافة إلى ذلك تم ملاحظه سلوكيات الحيوانات يومياً طوال مدة التجربة 0

أظهرت النتائج المتحصل عليها أن:

- 1- زيادة مستوى المركزات في العلائق يقلل وقت الأكل، الشرب، الأجتار، الوقوف ومعدلات الحركة وسلوك الأستكشاف 0 على النقيض من ذلك زادت مدة الرقاد والوقوف والتطير والنطح.
- 2- أدت التغذية على قش الأرز المعامل بالأمونيا إلى تقليل وقت الأكل، الأجتار، الرقاد بينما زاد وقت الوقوف والوقوف ساكناً
- 3- قضت الأبقار أثناء الثلث الثانى من موسم الحليب فترات أطول في تناول الطعام والأجتار والوقوف بينما قضت وقت أقل في الرقاد وتطير الجسم.
- 4- أصطحب الثلث الأخير من موسم الحليب اقل فترات شرب ماء، وقوف وأقل معدلات تطير للجسم والأستكشاف والتناطح بينما زادت فترات الرقاد.
- 5- أدت زيادة نسبة المركزات في العليقة إلى زيادة إنتاج اللبن ونسبه البروتين بينما أدت الى أنخفاض نسب الدهن ، الأكتوز، المواد الصلبة ونسبه المواد الصلبة غير الدهنيه 0
- 6- لم تظهر نوعيه المواد المائنه في العليقة تأثير واضح على إدرار اللبن ومكوناته 0
- 7- أدت الأبقار في الثلث الثانى من موسم الحليب كميات لبن أكثر ولكن بنسب منخفضة من الدهون، البروتين، الأكتوز، المواد الصلبة الكلية والمواد الصلبة غير الدهنية

