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# EFFECT OF OXYTOCIN ADMINISTRATION ON MILKING CHARACTERISTICS AND SOME PHYSIOLOGICAL RESPONSES OF BALADI COWS.

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## ABSTRACT

To examine the role of oxytocin in eliciting milk ejection, an experiment was conducted at El-Serw farm belonging to Animal Production Research Institute, Ministry of Agriculture. A total of 24 Baladi cows were divided into three equal symmetric groups and injected intramuscularly prior milking with either saline (control) or 5 IU and 10 IU oxytocin.

Administration of 10 IU of oxytocin produced shortest ($P<0.05$) milk let down time and milking time (2.0 and 4.2 min, respectively), also greatest ($P<0.05$) peak flow rate and average flow rate (1.0 and 0.62 kg/min, respectively).

Variations in stripping time (0.43 to 0.49 min) and in milk yield (2.2 to 2.7 kg/milking) were not significant, but more fat yield was harvested after administration of oxytocin (72.2, 95.3 and 94.4 g fat/milking for control, 5 IU and 10 IU oxytocin, respectively).

Normal nutritive constituents of milk (g/100ml), specific gravity and somatic cell count were not significantly affected by oxytocin injection. There were no significant effects of oxytocin administration on total plasma protein, GOT and GýPT, creatinine and bilirubin and cortisol levels. These findings indicate that oxytocin enhances milk ejection reflex without direct stimulatory action on mammary and body metabolism.

**Keywords*:*** *oxytocin, Baladi cows, milking characteristics, physiological responses.*

## INTRODUCTION

Lactating Baladi cows are considered low yielders and to some extent hard milkers, Morsy, *et al.* (1984). They have specific milking characteristics and behavioral reflexes that need consideration in milking practices. Eliciting milk ejection reflex in these animals may improve their milking characteristics.

Numerous experiments were done to determine the efficacy of exogenous oxytocin in eliciting milk ejection in dairy cattle using different doses (Graf, 1970; Sagi *et al.,* 1980; Gorewit *et al.,* 1983 and Hassan, 1985).
Other experiments were done to study if there is any stimulatory action of oxytocin on mammary metabolism (Allen, 1990; Ballou *et al.*, 1993 and knight, 1994).

Others studied if there is any inhibitory effect of oxytocin on lactogenesis and lactopiosis (Lane, *et al.*, 1970 and Graf *et al.*, 1973).

Another authors tried to find mechanisms involved in milk ejection rather than oxytocin involvement (Denamur, 1965 and Lefcourt and Akers, 1983).

The objectives of this study are to examine the efficacy of oxytocin administration prior to milking in eliciting and enhancing milk ejection in Baladi cows and if there is any role on the metabolic adaptation toward lactogenesis.

## MATERIALS AND METHODS

This experiment was carried out at El-Serw farm belonging to Animal Production Research Institute, Ministry of Agriculture. A total of twenty four multiparous lactating Baladi cows were divided into three equal symmetric groups according to their age, live body weight, parity and preceding lactations. Average age, body weight and parities of these groups were 4.5 year, 320 kg and 3 parities, respectively. The experiment started one week after calving and lasted for one month in lactation. All cows were fed a daily ration composed of concentrate mixture, Berseem (*Trifolium alexandrinum*) and rice straw as a roughage. The cows were fed according to NRC, (1988) allowances. Cows were machine milked (40 Cm Hg vacuum level, 15 pulsation cycle/ minute and 60:40 pulsation ratio) twice daily in a herringbone parlor. For these cows, oxytocin (Syntocinon®), was administered at different doses zero (saline), 5 IU and 10 IU/ cow twice daily (IU=0.5 µg of pure hormone). The quantity of oxytocin was injected intramuscularly in the gluteal region immediately followed by machine milking in the morning at 7 a.m. and evening at 6 p.m. Oxytocin injection was twice daily for one month. All cows were kept under semi shade yard and water was offered freely. Production data were recorded and biweekly milk samples of morning and evening milkings were collected. Specific gravity of milk was measured using Lactometer® immediately after milking. Milk constituents (fat, total protein, lactose total solids and solids not fat) were determined using Milkoscan® (133 B, N Foss Electric, Denmark).

Somatic cell counts (SCC, $X10^3$) were determined by Soma Count®, (150 Bentley Instruments, Minnesota, USA).

Milking characteristics, milk let down in minutes (time elapsed from injection till the start of milk flow), milking time in minutes, peak flow rate in kg/minute, average flow rate in kg/minute and stripping time in minute were recorded twice weekly. Blood samples were taken twice weekly from the jugular vein in heparinized tubes and centrifuged at 3000 rpm for 15 minutes and the collected plasma was stored at –20 $^0$C until analysis. Blood plasma was used for determination of total protein, glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GPT), Creatinine, using commercial kits purchased from Biomerieu Rains, France. But plasma Bilirubin concentrations were determined using kits supplied by Diamond® Diagnostics, Egypt. Total protein was determined using the method by Sundeman, (1964). Bilirubin was estimated by the method of Ducci and Watson, (1945). The activities of GOT and GPT were estimated by the method of Reitman and Frankel, (1957). Plasma creatinine was quantified according to Bartles, *et al*. (1972).

Single antibody radioimmuno assay was performed for assessment of plasma Cortisol, DPC, California, USA according to Boyd and Hogg, (1981).

Data were analyzed using the general linear model of SAS (SAS, 1995). Differences among means were determined by Duncan multiple range test (Duncan, 1955).

## RESULTS AND DISCUSSION

### 1. Milking characteristics

Milking characteristics as affected by various doses of oxytocin injection are presented in table 1.

**Table 1. Least square means ± SE for milking characteristics and production data as affected by various doses of oxytocin administered prior to milking.**

| Variable | Oxytocin (IU/ milking) | | |
|---|---|---|---|
| | **0** | **5** | **10** |
| Milk let down time, min | $3.35^{a} \pm 1.15$ | $2.10^{b} \pm 1.10$ | $2.00^{b} \pm 1.15$ |
| Milking time, min | $-4.65^{a} \pm 2.50$ | $4.25^{b} \pm 1.95$ | $4.2^{b} \pm 1.45$ |
| Peak flow rate, Kg/min | $0.86^{a} \pm 0.15$ | $1.07^{b} \pm 0.25$ | $1.00^{b} \pm 0.15$ |
| Average flow rate, Kg/min | $0.47^{a} \pm 0.01$ | $0.60^{b} \pm 0.01$ | $0.62^{b} \pm 0.02$ |
| Stripping time, min | $0.48^{a} \pm 0.15$ | $0.44^{a} \pm 0.12$ | $0.45^{a} \pm 0.19$ |
| Milk yield, Kg/milking | $2.15^{a} \pm 0.15$ | $2.5^{a} \pm 0.24$ | $2.55^{a} \pm 0.19$ |
| Fat yield, g/milking | $72.2^{a} \pm 2.3$ | $95.3^{b} \pm 3.2$ | $94.4^{b} \pm 2.5$ |
| Milk constituents, g/100ml | | | |
| Fat | $3.36^{a} \pm 0.1$ | $3.81^{b} \pm .04$ | $3.7^{b} \pm 0.11$ |
| Protein | $2.89^{a} \pm 0.12$ | $3.07^{a} \pm 0.09$ | $3.10^{a} \pm 0.01$ |
| Lactose | $4.88^{a} \pm .02$ | $5.00^{a} \pm 0.02$ | $5.13^{a} \pm .06$ |
| Total solids | $12.05^{a} \pm .20$ | $12.54^{a} \pm 0.14$ | $12.75^{a} \pm 0.22$ |
| Solids not fat | $8.56^{a} \pm 0.15$ | $8.80^{a} \pm 0.15$ | $9.07^{a} \pm 0.10$ |
| Specific gravity | $1.029^{a} \pm 0.01$ | $1.031^{a} \pm .02$ | $1.03^{a} \pm 0.03$ |
| Somatic cell count, X$10^3$ | $67.7^{a} \pm 12.0$ | $69.1^{a} \pm 15.0$ | $70.2^{a} \pm 15.0$ |

**$^{ab}$LS means with the same superscript, in same row, were not significantly (P<0.05) different.**

Only as low as 5 IU oxytocin (2.5 µg of pure hormone) administered intramuscularly was enough to induce spontaneous conditioning after a latent period of 2 minutes for circulation of the hormone from the injection site to the udder. Shortest (P<0.05) milk let down time and milking time and greatest (P<0.05) peak flow rate and average flow rate were recorded as a result of oxytocin injection. The differences in the magnitude of the effect of the two oxytocin doses were not significant. There was no significant effect of oxytocin injection on stripping time.

Many investigators induced milk ejection and stimulated animals for better milking characteristics in both cows and buffaloes by using natural or synthetic oxytocin (Graf, 1970, Sagi *et al.*, 1980 and Bruckmaier *et al.*, 1997).

### 2.Production data

Milk yield per milking, milk constituents (fat, protein, lactose, total solids, solids not fat) and somatic cell counts are presented in table 1.
Administration of 5 IU and 10 IU of oxytocin caused a non significant increase in milk yield over the control group by 16.3 and 18.5 %, respectively.

The results are in agreement with the findings obtained by Sagi, *et al.* (1980) and Ballou *et al.* (1993).

On the other hand, Hassan, (1985) found that injection of 30 IU oxytocin significantly decreased the total milk yield of cross-bred dairy cows but not that at buffalo cows.

Injection of supra-physiological doses of oxytocin (≥30 IU) caused a decline in milk yield (Allen, 1990).

Despite of the non significant effect of oxytocin on the milk yield more (P<0.05) fat yield was harvested from Baladi cows as a result of oxytocin injection.

These findings demonstrate that oxytocin insures the complete evacuation of milk from alveoli, duct system and cisterns, this will reduce the amount of residual milk which is extremely high in fat. Also, the low productivity of such cows did not express the magnitude of enhancing the milk ejection reflex which happened by oxytocin injection.

Milk constituents (protein, lactose, total solids and solids not fat) and specific gravity of milk did not significantly differ between control and treated cows.

Another trends were reported by Lane, *et al.*, (1970), who said that fat percent of cows increased through the first oxytocin dose, then decreased to approximately the fat content of normal milkings. Also, they found that other milk constituents (solids not fat, protein and lactose were all significantly lower in milk removed after the injection of oxytocin than that taken during normal milking.

But, Allen, (1990) reported unchanged milk fat yield and a decline in lactose and protein content.

The present results and those of Ballou *et al.* (1993) refutes the claim that oxytocin injection effects may be manifested through an effect on mammary cell remodeling and its only action is to enhance the milk ejection reflex.

There were no significant effects of oxytocin injection (5 IU or 10 IU) on the somatic cell count in milk, which showed that the induction of conditioning using exogenous oxytocin did not affect the udder health. Similar trends were reported by Thomas and Fell, (1985) and Ballou *et al.* (1993). Normal somatic cell count in Friesian cows milk was estimated to be less than 10,000/ ml milk, Thiel and Dodd, (1979).

**3.Blood parameters**

All values of blood constituents were in the normal range of cattle reported by Reece, (1992). Plasma values of total protein, GOT, GPT, creatinine, bilirubin and cortisol are presented in table 2.

**Table 2. Least square means ± SE for some physiological parameters of blood as affected by various doses of oxytocin administered prior to milking.**

| Items | Oxytocin (IU/ milking) | | |
|---|---|---|---|
| | **0** | **5** | **10** |
| Total Protein (g/dl) | $7.2^{a} \pm 0.13$ | $7.9^{a} \pm 0.14$ | $8.0^{a} \pm 0.15$ |

| | | | |
|---|---|---|---|
| GOT (u/dl) | 62.1 [a] ± 2.79 | 59.2 [a] ± 4.24 | 67.1 [a] ± 2.67 |
| GPT (u/dl) | 25.5 [a] ± 1.01 | 24.1 [a] ± 0.48 | 26.4 [a] ± 2.50 |
| Creatinine (mg/dl) | 0.46 [a] ± 0.08 | 0.49 [a] ± 0.04 | 0.51 [a] ± 0.03 |
| Bilirubin (mg/dl) | 0.24 [a] ± 0.03 | 0.44 [a] ± 0.08 | 0.47 [a] ± 0.60 |
| Cortisol (µ g/dl) | 2.66 [a] ± 0.51 | 2.88 [a] ± 0.36 | 2.85 [a] ± .60 |

**[ab]LS means with the same superscript, in same row, were not significantly (P<0.05) different.**

There are no significant effects of both oxytocin doses (5IU and 10 IU) on all blood parameters. Administration of 5 IU and 10 IU oxytocin did not affect the activity of GOT and GPT which showed that oxytocin did not affect the metabolic activity of the body organs, this is in agreement with Knight, (1994) and Bruckmaier and Blum, (1998).

Administration of 5 IU and 10 IU oxytocin increased total plasma protein by 9.7 and 11 %, respectively. Despite of the little increases noticed in total plasma protein there were no direct effects of oxytocin on the metabolic adaptations associated with lactogenesis.

Another slight increase in creatinine and bilirubin was produced by oxytocin injection of 5 IU and 10 IU (6.5 and 11% for creatinine and 5 and 11.9% for bilirubin, respectively).

The present results indicate that oxytocin injection is not involved in a such mechanisms dealing directly with hepatic and kidney function. But oxytocin might regulate the tremendous shifts of fluids and ions associated with lactogenesis, and the kidney may indirectly involved. This is in agreement with, Allen, (1990) who tried to study the leakage of some milk constituents into blood and the role of kidney in the clearance of such constituents as a result of oxytocin injection.

Some proposed roles of oxytocin were suggested by Denamur, (1965) and Lefcourt and Akers, (1983). Who reported an Insulin like activity of oxytocin which may stimulate lipogenesis and increase pyruvate dehydrogensase activity in rats. Another role they proposed, an increase in peripheral concentrations of lipids to replenish its loss during milking.

## CONCLUSION

The present study elucidated the efficacy of exogenous oxytocin to facilitate and enhance the milk ejection reflex of lactating Baladi cows. Also, oxytocin improves all milking characteristics of these animals and improves their response toward machine milking (i.e., let them accustomed faster to machine milking).

There were no significant effects of the hormone on the blood physiological parameters, which illustrate that oxytocin does not exert any effects on the metabolism of the mammary gland and the body.

This research needs a further studies to investigate the other roles that may be played by oxytocin in the physiology of lactating ruminants.

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## تأثير الحقن بالأوكسيتوسين على خصائص الحلب و بعض الاستجابات الفسيولوجية في الأبقار البلدية.

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أجرى هذا البحث في محطة السرو التابعة لمعهد بحوث الإنتاج الحيواني بوزارة الزراعة. لدراسة تأثير الأوكسيتوسين علي خصائص إدرار اللبن, وتم تقسيم ٢٤ بقرة بلدي إلى ثلاث مجموعات متقاربة من حيث العمر (٤,٥ سنة) و الوزن (٣٢٠ كجم) وعدد مواسم الحلب (٣ مواسم) و متساوية من حيث العدد (٨ بقرات لكل مجموعة) . المجموعة الأولى تم حقنها بمحلول فسيولوجى (كلوريد صوديوم 0.9 % ) و الثانية تم حقنها بهرمون الأوكسيتوسين ٥ وحدة دولية و الثالثة ١٠ وحدة دولية من نفس الهرمون. وذلك لكل بقرة مرتين يوميا قبل الحلب مباشرة ولمدة الشهر الأول بعد الولادة. أخذت عينات لبن مرتين أسبوعيا للتحليل وقياس الكثافة النوعية و النسب المئوية لكل من الدهن و البروتين والجوامد الكلية و الجوامد اللادهنية و العدد الكلي للخلايا الجسمية. و كذلك أخذت عينات دم مرتين أسبوعيا للتحليل وقياس كل من مستوى البروتين الكلى بالدم و مستوي الأنزيمات GPT, GOT وتركيز الكرياتينين والبيليروبين ومستوى هرمون الكورتيزول.

أقترن الحقن ب١٠ وحدة دولية للأوكسيتوسين بأقصر (P< 0.05) زمن تحنين (٢ دقيقة) و أقصر زمن حلب (٤,٢ دقيقة) أيضا أسرع (P< 0.05) أقصى معدل تدفق و متوسط معدل تدفق (١,٠ و ٠,٦٢ كجم لبن/ دقيقة على الترتيب).

لم يكن هناك اختلافا معنويا في زمن التقطير (٠,٤٤ إلى ٠,٤٨ دقيقة ) كذلك في محصول اللبن (٢,١٥ الي ٢,٥٥ كجم/ حلبة), لكنه تم الحصول على محصول دهن أكبر لكل حلبة (P< 0.05) حيث كان كالتالي (٧٢,٢، ٩٥,٣ ، ٩٤,٤ جم دهن/ حلبة لكل من الكنترول و٥ وحدة دولية و١٠ وحدة دولية أوكسيتوسين على الترتيب).

لم يكن للحقن بالأوكسيتوسين تأثير معنوي علي تركيب اللبن والكثافة النوعية والعدد الكلى للخلايا الجسمية به وكذلك في مستوى البروتين الكلى بالدم و مستوي الأنزيمات GPT, GOT وتركيز الكرياتينين والبيليروبين ومستوى هرمون الكورتيزول في بلازما الدم.

أوضحت نتائج الدراسة أن الحقن بهرمون الأوكسيتوسين أدي الي زيادة كفاءة إدرار اللبن دون احداث أي تأثيرات مباشرة على التمثيل الغذائي للغدة اللبنية أو وظائف بعض أعضاء الجسم .