MILK SECRETION IN EGYPTIAN BUFFALO UNDER DIFFERENT PREPARTUM AND POSTPARTUM MILKING SCHEMES

By

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B.Sc. Agric. Sci. (Animal Production), Fac. Agric., Cairo Univ., 2001
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APPROVAL SHEET

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Title of Thesis: Milk Secretion in Egyptian Buffalo under Different Prepartum and Postpartum Milking Schemes
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Department: Animal Production **Branch:** Animal Production
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ABSTRACT

The effect of different periparturient milking schemes on colostrum and milk yield and composition of buffalo was studied. Morover, some lactogenic hormones were mesured. Some blood plasma metabolites were quantified. Ninteen healthy multiparous late pregnant buffalo cows were divided into 4 groups: 1) the control group (n=5) was machine milked twice a day (2×) for the first 100 DIM. 2) Prepartum milking group (PM, n=5), animals were hand milked twice a week starting 30 days before the expected calving date until the day of parturition, afterword, they were machine milked 2× from parturition until 100 days postpartum. 3) Prepartum milking+Frequent milking group (PM+FM, n=5), animals were subjected to the same milking regime as in PM group except the period from 7 to 21 days postpartum, the daily milking frequency were increased from 2× to 3× then returned to 2× untill the end of the experiment. 4) Unilateral milking frequency group (UMF, n=4), the left udder side of each animal was subjcted to the same pre- and post-partum milking schemes as in PM+FM group, while the right udder sides were treated as the control group.

Precolostrum secretion can be described as hony-like pale yellow secretion which dries fast when exposed to air. The amount of precolostrum ranged from no secretion to 770 g/milking. Precolostrum secretion is high in protein and ash, while, low in fat and lactose compared to colostrum. Prepartum milking caused an increase in colostrum yield by 23% compared to control. Colostrum fat% was lower by 14% in prepartum milked animals than control while colostrum protein and lactose% showed no differences due to prepartum milking scheme. Milk yield, 4% fat corrected milk (FCM) and energy corrected milk (ECM) were increased ($P<0.05$) by 10, 20 and 27%, respectively, for PM group compared to the control. The PM group showed also a significant increase in milk protein%, fat, protein and lactose yields compared to the control. Meanwhile, milk yield was higher ($P<0.05$) for PM+FM compared to both PM and the control group by 17 and 30%, respectively. Yield of FCM and ECM were also higher for PM+FM compared to control by 25 and 36%, respectively. Milk protein% was inceased ($P<0.05$) in both PM and PM+FM compared to the control. Milk fat, protein and lactose yield showed higher values for the PM+FM group over the PM and the control groups. Milk electrical resistance was higher in the PM+FM compared to the PM and the control. Unilateral frequent milking did not show any differences in milk yield or milk composition between the treated udder sides. The different plasma hormones and surveyed in this study did not show any differece due to different milking schemes. The effect of time from parturition was significant on some of them (i.e. preogesterone, estradiol, prolactin, glucose, albumin, cholesterol, triglycerides, calcium and phosphorus).

Key words: Buffalo, prepartum milking, milking frequency, unilateral milking, lactogenic hormones, blood metabolites.

DEDICATION

*I dedicate this work to my precious mother **Samia** and my beloved brother **Fady** for all the love and support they kindly give me along the journey of my life. Special dedication to my father **Nabil Kamel Guirguis,** God rest his soul and I want him to know that he was and will be my light in the darkness of life. Another dedication is to my best friend **Nadia Rasmy** for her continues support and help and for never letting me down. Last but not least I thank God and I knell before him for all the blessing he gives me.*

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ABBREVIATIONS

1×	: Milking once a day
2×	: Milking twice a day
3×	: Milking thrice a day
4×	: Milking four times daily
6×	: Milking six time daily
AMP	: Animals milked prepartum
BW	: Body weight
Ca	: Calcium
DIM	: Days in milk
DMI	: Dry matter intake
E2	: Estradiol-17β
ECM	: Energy corrected milk yield
ELISA	: Enzymatic linked immuno sorbent assay
ER	: Electrical resistance
FCM	: Fat corrected milk yield
FCR	: Feed conversion ratio
FIL	: Feedback Inhibitor of Lactation
GH	: Growth Hormone
IGFBP	: Insulin like growth factor binding protein
IGF-I	: Insulin like growth factor I or somatomedin-C
Igs	: immunoglobulins
IMF	: Increasing milking frequency
irGH	: Immunoreactive growth hormone
NEFA	: Non-esterified fatty acids

ABBREVIATIONS (continued)

ODM : Once-daily milking

P : Phosphorus

P4 : Progesterone

PM : Prepartum milked group

PM+FM : Prepartum milked plus postpartum frequent milking group

PRL : Prolactin

SCC : Somatic cell count

UMF : Unilateral milking frequency

α-La : Alpha-lactalbumin

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INTRODUCTION

Buffaloes are a multipurpose animal in a number of countries around the world. Unfortunately, buffalo milk production is pretty low when compared to dairy cattle. Moreover, in many farming systems, prolonged postpartum anoestrus is a major problem, and the causes include; poor nutrition, poor body condition, stress due to harsh climates and improper management (Perera, 2011), in addition to the lack of national breeding plan which weakness the possible improvement of production.

Increasing milk yield, improving milk quality, ensuring udder hygiene and maintaining the general health of dairy animals are the main targets of the dairy industry personnel's. Mammary gland performance influences the entire dairy industry, and manipulation of mammary function could be used as a tool for increasing productivity. Thus, from an economic point of view, gaining control over mammary epithelial cell proliferation may be a key to increase dairy milk production (Bierła *et al*., 2012).

During the periparturient period, multiple changes occur in animal physiology that adapts the body to be transferred from non-lactating pregnant to lactating non-pregnant status. Changes in the hormonal levels adapt both the body and the mammary gland in order to produce milk for the nourishment of the newly born calf. Different hormones are involved in the adaptation of the mammary gland for colostrogenesis and milk production (e.g. progesterone, estrogen, prolactin, corticosteroids, growth hormone … etc.) (Convey, 1974 and Barrington *et al*., 2001).

Prepartum milking have been suggested as a promising practice for increasing milk production and improving animal health in the subsequent lactation in both heifers and multiparous dairy cattle (Smith and Keyes, 1953; Zeliger *et al*., 1973 and Daniels *et al*., 2007). Different researches examined the beneficial effect of prepartum milking on udder hygiene during subsequent lactation (mainly udder edema and mastitis prevention) (Santos *et al*., 2004; Bowers *et al*., 2006 and Daniels *et al*., 2007). Meanwhile, other researches concentrated on the effect of prepartum milking on animal general health (mainly milk fever) (Smith and Blosser, 1947; Greene *et al*., 1988 and Kronqvist *et al*., 2014). It was concluded that prepartum milking has a potential positive effect on both increasing milk production and improving the udder hygiene and general health of lactating animals' particularly first calf heifers.

On the other hand, increasing milking frequency (IMF) is another management tool that proved to be effective in increasing milk yield. This practice has been used to increase milk yield in high yielding dairy cattle without having any negative alteration either on animal health or on milk component yield (Erdman and Varner, 1995; Smith *et al*., 2002; Eslamizad *et al*., 2010 and Wright *et al*., 2013). Nevertheless, the reported increases in milk yield as a result of IMF varied widely among different studies from 10 to 20% (Wall and McFadden, 2008). Moreover, IMF for only few days in early lactation (from day 1 to 21 of lactation) was reported to have a positive impact on milk production. Moreover, a carryover effect, the persistency of producing higher milk yield compared to control after the cessation of the more milking frequency and returning to the normal milking frequency, was also reported to proceed after the cessation of early IMF and returning to normal 2× (Pearson *et al*., 1979; Poole, 1982; Bar-Peled *et al*., 1995; Hale *et al*., 2003; Dahl *et al*., 2004a and Wall and McFadden, 2008). Thus, IMF can be used as an improving management tool to increase buffalo milk production through modulating mammary cell turnover and activity.

Unilateral frequent milking (UFM) was suggested and has been used as a valid and effective model for investigating the effects of frequent milking (Wall and McFadden, 2007a). Many studies had pointed out that the effect of increasing milking frequency is locally regulated (knight *et al*., 1998 and Wall and McFadden, 2007a). Thus, half-udder design is extremely powerful because it eliminates variation between animals attributed to genetics, environment and nutrition (Stelwagen and Knight, 1997; Wall and McFadden, 2007b and Murney *et al*., 2015).

Therefore, this study was aimed to investigate the effect of prepartum milking on colostrogenesis and milk production of the subsequent lactation season in Egyptian buffalo. It is also aimed to study the effect of increasing milking frequency, for only 14 days in early lactation, on buffalo lactation performance and the presence of carryover effect if any. Moreover, unilateral milking was studied to experiment the different local effects on milk yield of lactating buffalo under the Egyptian condition. All the studied production parameters under the mentioned investigated schemes were in relation to the relevant blood hormonal and biochemical constituents.

REVIEW OF LITERATURE

1. Prepartum milking and its schemes

Greene *et al*. (1988) described prepartum milking as; milking dairy animal at frequent intervals prior to calving. Prepartum milking is closely related to the onset of lactogenesis stage II. Lactogenesis is a complicated physiological process which consists of a series of events in the differentiation process whereby mammary cells are converted from non-secretory to secretory state. It is usually defined as the onset of lactation or induction of milk synthesis. Lactogenesis takes place in two stages; the first named lactogenesis stage I, which occurs during late pregnancy, consists of cytologic and enzymatic differentiation of alveolar cells and coincides with limited milk secretion before parturition when variable amounts of lactose could be observed in the mammary gland and it is also referred to as “secretory differentiation”. The second named lactogenesis stage II or secretory activation consists of copious secretion of all products of milk and begins approximately 0 to 4 days before parturition and extends through a few days postpartum and it is marked by substantial increase in lactose synthesis, by changes in expression of genes involved in milk protein and lipid synthesis (Tucker, 1981 and Neville, 2009).

Milk yield is a function of the number of secretory cells present in the udder and the metabolic activity of these cells (Stelwagen, 2001). Thus, both parameters determine the future milk yield potential of the mammary gland. Nickerson and Akers (1984) stated that lactation requires at least three interrelated events: (1) prepartum proliferation of alveolar epithelial cells; (2) biochemical and structural