EFFECT OF SOME PHYSIOLOGICAL AND MECHANICAL FACTORS ON MACHINE MILKING TRAITS OF EGYPTIAN BUFFALOES

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SUMMARY

This work was done on 24 lactating buffaloes; 12 first and 12 multicalvers belonging to the herd of the Faculty of Agriculture, Cairo University located at Om Saber farm, South Tahreer.

Overall least squares means of the four machine milking traits studied were 1.37 min., 5.17 min., 4.59 kg. and 0.95 kg./min. for stimulation time, milking time, milk yield and rate of flow in morning milking, in respective order. The corresponding means for evening milking were 1.53 min., 3.86 min., 2.85 kg. and 0.79 kg./min for the above four traits, in respective order.

The effect of parity was significant ($P<.01$) on all traits, except for morning stimulation time. Coefficients of regression of all traits on either stage of lactation or milk yield were significant ($P<.01$), except for those of stimulation time and morning rate of flow on stage of lactation.

Machine adjustment experimented improved considerably the efficiency of milking operation. Raising vacuum level from 35 to 40 cm. Hg. reduced, significantly, stimulation and milking time and accelerated rate of milk flow. Further increase to 50 cm.Hg. increased morning milk yield. Increasing pulsation rate from 50 to 60 cyc./min. reduced, significantly, evening milking time, increased morning milk yield and accelerated rate of flow in both milkings. Alternative pulsation increased the amount of milk harvested by 10 % over simultaneous pulsation.

INTRODUCTION

Labor for milk harvest account for over 50% of routine operational requirements on a dairy farm (Albright, 1964). Also, labor require about 80% of annual milking costs. The spread of large size herds and the going up wages elaborated the widespread of machine milking in cattle herds. The extensive studies conducted to improve the economics of machine milking in cattle yielded great advances in this field. However, Aliev (1970) stated that "The advances made in machine milking of cows cannot be directly applied to buffaloes, since the physiology of the mammary gland of the latter has some features peculiar to them".

The success in using machine milking is considered one of the important aspects of improving the production economics of the main dairy animal in Egypt "the Buffaloes". Considerable research effort should be devoted to cover the various aspects of this subject. So far, almost, only two studies were executed in Egypt (Hassan, 1970 and Aboul Ela, 1973) to study the response of Egyptian buffaloes to machine milking.

The main objective of this study was to define the optimum machine parameters for milking buffaloes of different parities and production levels at the various stages of lactation. This was done by investigating the effect of some physiological and mechanical factors thought to have close relation with the efficiency of milking operation.

MATERIAL AND METHODS

This study was carried out at Om Saber farm, South Tahreer. A total number of 24 buffaloes belonging to the herd of the Faculty of Agriculture, Cairo University, located at Om Saber farm was included in the study. Out of this number 12 heads were primiparous (heifers) and the other 12 represented parities from the 2nd to the 5th lactation. Buffaloes also represented different stages of lactation (all beyond peak yield point).

A preparatory trial has been executed for two weeks on machine milking where stimulation and stripping were performed by hand. Since the start of the study on May 3, 1980, all operations, i.e. stimulation, milking and stripping were done by machine till the experiment terminated by June 22, 1980.

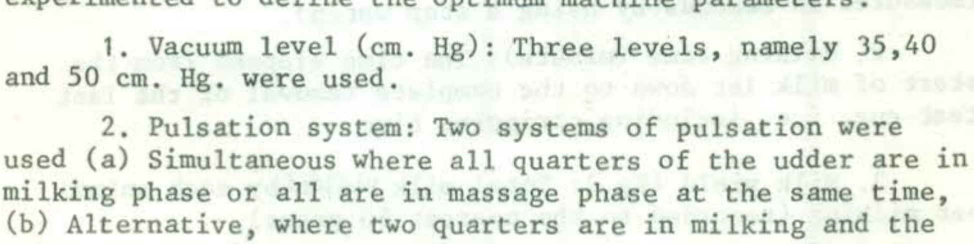
The machine used was double-bucket for milking two animals simultaneously and was kindly gifted by "Fullwood International", U.K. The following machine adjustments were experimented to define the optimum machine parameters:

1. Vacuum level (cm. Hg): Three levels, namely 35,40 and 50 cm. Hg. were used.

2. Pulsation system: Two systems of pulsation were used (a) Simultaneous where all quarters of the udder are in milking phase or all are in massage phase at the same time, (b) Alternative, where two quarters are in milking and the other two are in massage phase and so on, alternatively.

3. Pulsation rate (cycles/minute): Two rates, namely 50 and 60 cycles/minute were tried.

The design of the experiment and the distribution of the 24 animals by parity and machine parameters classes are shown in the following diagram:



where SIM = Simultaneous, ALT = Alternative ,
H = Heifer and M = Multiparous.

The pairs of a heifer and a multiparous buffalo were alloted randomly to the 12 machine parameters cells shown above.

Buffaloes were milked twice a day at 6 a.m. and 2.30 p.m. and the following traits were recorded for each individual animal:

1. Stimulation time (minute): The time from applying the last teat cup to the udder to the start of milk let down (measured in seconds by using a stop watch).

2. Milking time (minute): The time elapsed from the start of milk let down to the complete removal of the last teat cup, i.e. including stripping time.

3. Milk yield (Kg.): Total milk yielded by each animal per milking (recorded to the nearest 50 grams).

4. Rate of milk flow (Kg./min.): Total milk yielded in a single milking divided by respective machine milking time.

Analysis of variance for each of the four above-mentioned traits was carried out using least squares method (Harvey 1960)to calculate the main effects of vaccum level, pulsation system, pulsation rate and parity. The model used included also the regression term of each trait on the stage of lactation expressed in number of days in milk, postpartum. Separate analysis was performed in which each trait was regressed on yield per single milking instead of stage of lactation. Significance of differences between individual means were tested applying Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The satisfactory response and temperament of buffaloes in machine milking throughout the pilot trial, lasting two weeks, suggested the full mechanization of the whole milking operation. Thus, stimulation, milking and stripping were all done by machine in this work.

1. Stimulation and milking times:

Means and standard errors of stimulation time and milking time are shown in Table 1 and analyses of variances of these traits are presented in Table 2. The stimulation time was shorter in morning than in evening milking while the reverse was true for milking time. The different amount of milk existing inside the udder before each milking could be considered the reason for these differences.

Parity had significant effect on stimulation time in the evening milking. The effect was more apparent on milking time of both milkings ($P<.01$, Table 2). Stimulation time decreased while milking time increased by advance in parity up to the third lactation and the reverse occurred thenafter. Again, the reason could be the variable amount of milk yield of animals belonging to different parities. Also, Mc Donald (1968) found that multiparous cows have both longer and more dilated streak canals than primiparous cows. The great single increase occurred during the second of four consective lactations.

Milking time in both milkings was regressed negatively on stage of lactation. On the average, an advance of 10 days in milk reduced milking time by 0.1 and 0.06 minutes in both morning and evening milkings, respectively. These results are in agreement with those of Aboul Ela (1973) on Egyptian buffaloes and with those of Schultz (1958) and Schmidt and Van Vleck (1969) on cattle.

When stimulation and milking time were regressed on yield of milk, the coefficients were significant at the 1 % level. An increase of one kilogram in yield decreased stimulation time by 0.11 and 0.15 minutes and increased milking time by 0.59 and 0.68 minutes in morning and evening milkings, in respective order.

Vacuum level, when raised from 35 to 40 cm.Hg., decreased evening stimulation time and morning and evening milking times with no significant effect for further increase to 50 Cm.Hg. Aliev (1969) showed that higher vacuum level is required to overcome the teat sphincter in buffaloes than in cows. The author reported that increased vacuum level for milking buffaloes reduces milking time and increases rate of milk flow with no harmful effect on udder health. The present results are in agreement with those of the studies conducted on Egyptian baffaloes (Hassan, 1970 and Aboul Ela, 1973).

Pulsation rate reduced significantly morning milking time (P<.01). The increase from 50 to 60 cycles per minute resulted in a reduction of 0.37 minute in morning milking time. With respect to pulsation system, operating the alternative pulsation reduced stimulation time in both milkings by 11% less than time required when simultaneous system was operated. On the contrary, milking time was increased by 6% in morning milking. However, when total time required for stimulation and milking in the whole day is considered, differences between the two systems got negligible and do not exceed 1% of the total time.

2. Milk yield:

Machine milk yield considered here included stripping milk . Means and standard errors of the trait are shown in table 3 and its analysis of variance is presented in table 4. Differences in yield of both morning and evening milkings due to parity were significant at the 1% level. Morning yield increased gradually up to the second lactation while evening yield increased up to the third lactation, the yield declined gradually thereafter. These results supported those of Aboul Ela (1973)and Ragab et al. (1973) on Egyptian buffaloes.

The regression of milk on stage of lactation was significant (Table 4, P<.01). An increase of 10 days in milk decreased the yield by 0.1 kg.of milk.

Vacuum level, when raised to 50 cm.Hg.,increased significantly the morning yield (6 %)over the corresponding yields obtained for the other two levels of vacuum (35 and 40 cm.Hg. The same increase in morning yield was obtained when pulsation rate was increased from 50 to 60 Cycles per minute.The explanation could then be related to the more efficient evacuation of the udder by more benifit from oxytocin, particularily when the amount of milk evacuated is large (morning milking in this case).

Alternative pulsation system increased (P<0.01)morning and evening yields by 9%&11%, respectively over corresponding yields obtained by simultaneous system.

3. Rate of milk flow:

Means and standard errors of rate of milk flow are shown in table 5 and the analysis of variance of the trait is presented in table 6. The overall mean was higher in morning than in evening milking (0.95 vs.0.79 Kg./min.) most probably due to the differences in the intramammary pressure of the udder caused by the amount of milk to be harvested in each milking.

Parity exerted the same trend seen earlier, i.e. rate of flow increased up to the second lactation and tended to decline slightly thenafter. The most marked single differences were that between the first and the successive three lactations in the morning, and that between the first and the sucessive two lactations in the evening milking. The differences could be reasonably attributed to the variable amount of milk and to the anatomical differences in the mammary gland (Mc Donald 1968).

Regression of rate of flow on stage of lactation was negative and reached the level of significance in evening milking only. When stage of lactation was replaced by milk yield, the regression of milk flow on the latter was positive and significant (P<.01)in both milkings. The increase in the amount of milk inside the udder raises the internal pressure and accelerates, consequently, the rate of milk flow.

Machine adjustments played an important role in determining rate of milk flow and all of them showed highly significant effect (except that of pulsation system)on rate of milk flow in morning milking (table 6).Increasing vacuum level from 35 to 40 cm.Hg. resulted in an increase of 31 and 24% in rate of flow in morning and evening milkings, respectively. No marked advantage was detected for further increase of vacuum level to 50 Cm. Hg. The increase in rate of milk flow due to increasing pulsation rate from 50 to 60 cyc./min. was 17% and 8% in morning and evening milkings, respectively.Also, pulsation system increased rate of flow by 11% when changed from simultaneous to alternative pulsation. In general, the advantage of machine adjustment got more pronounced in the morning milking due to the large amount of milk in the udder.

Conclusions:

The present study showed the considerable contribution of the optimum machine parameters to the efficiency of machine milking of buffaloes. Both proper vacuum level and pulsation rate reduced significantly the milking time, accelerated the rate of milk flow and increased the milk harvested. Alternative pulsation in turn contributed largely to the improvement of milking efficiency and to the cutting down of its cost.

The study also confirmed the feasibility of full mechanization of the milking operation in buffaloes. The use of machine for stripping buffaloes was recommended by Aliev (1970) as it was found to raise productivity, improve hygienic quality of milk and reduce the frequency of incidence of udder diseases.

The significant influences of parity, stage of lactation and milk yield on almost all traits considered refer to the importance of considering these factors when the machine would be adjusted for milking buffaloes. The study raised the questions about the effect of the interval between successive milkings on efficiency of machine milking and indicated the need for further research work on the effect of machine milking on important dairy traits such as persistency, total milk production and milk constition of buffaloes. A comparative study concerning the different aspects of both hand and machine milking should be considered in this respect.

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Table (1): Least squares means*of stimulation time and milking time

Classification	N	Stimulation time(min.)				Milking time (min.)			
		Morning		Evening		Morning		Evening	
		$\bar{X}$	S.E.	$\bar{X}$	S.E.	$\bar{X}$	S.E.	$\bar{X}$	S.E.
Overall	457	1.37	.04	1.53	.04	5.17	.08	3.86	.06
Parity:									
1	136	1.41a	.06	1.44a	.07	4.66a	.12	3.60a	.10
2	49	1.36a	.11	1.39ab	.12	5.43bc	.22	4.05b	.18
3	83	1.35a	.09	1.37ab	.11	5.82b	.18	4.16c	.16
4	146	1.39a	.07	1.66c	.08	4.91a	.14	3.79ab	.12
5	43	1.40a	.12	1.78c	.13	5.02ac	.23	3.69ab	.19
Vacuum level:									
35 cm.Hg.	142	1.38a	.08	1.74a	.20	6.20a	.16	4.49a	.14
40 cm.Hg.	155	1.42a	.06	1.45b	.07	4.68b	.12	3.55b	.10
50 cm.Hg.	160	1.32a	.06	1.39b	.07	4.63b	.12	3.53b	.10
Pulsation rate:									
50 cyc./min.	308	1.32a	.04	1.53a	.05	5.35a	.08	3.94a	.07
60 cyc./min.	149	1.42a	.06	1.52a	.07	4.98b	.12	3.78a	.10
Pulsation system:									
Simultaneous	208	1.45a	.05	1.62a	.05	5.01a	.09	3.84a	.08
Alternative	249	1.29b	.06	1.43b	.07	5.32b	.11	3.87a	.10
Reg.on stage of lactation	457	- .001	.001	.0001	.0008	-.011	.001	- .006	.001

* Means not followed by same letter differ significantly at the 5% level.

Table (2): Least squares analyses of variances of stimulation time and milking time

Source of variance	d.f.	Mean Squares Stimulation Morning	time Evening	Milking Morning	time evening
Parity	4	0.11 NS	1.65*	17.36**	4.45**
Vacuum level	2	0.35 NS	2.39*	53.90**	20.30**
Pulsation rate	1	1.02 NS	0.01 NS	19.68**	2.60 NS
Pulsation system	1	2.10 *	3.02*	8.05*	0.09 NS
Reg.on stage of lactation	1	1.18 NS	0.01 NS	113.71**	30.82**
Residual	447	0.46	0.57	1.74	1.23

NS not significant * Significant at the 5% level ** Significant at the 1% level.

Table (3): Least squares means* of machine milk yield (in kilogram)

Classification	N	Morning		Evening	
		$\bar{X}$	S.E.	$\bar{X}$	S.E.
Overall	457	4.59	0.05	2.85	0.04
Parity:					
1	136	3.69 a	.08	2.39 a	.05
2	49	5.21 b	.14	3.09 b	.10
3	83	5.10 b	.12	3.32 b	.08
4	146	4.61 c	.09	2.81 c	.06
5	43	4.31 c	.14	2.64 c	.10
Vacuum level:					
35 cm.Hg	142	4.56 a	.10	2.82 a	.07
40 cm.Hg.	155	4.46 a	.07	2.83 a	.05
50 cm.Hg.	160	4.73 b	.08	2.90 a	.06
Pulsation rate:					
50 cyc./min.	308	4.46 a	.05	2.85 a	.04
60 cyc./min.	149	4.72 b	.07	2.86 a	.05
Pulsation system:					
Simultaneous	208	4.40 a	.06	2.70 a	.04
Alternative	249	4.78 b	.07	3.00 b	.05
Reg. on stage of lactation	457	-.010	.001	- .008	.001

* Means not followed by same letters differ significantly at the 5 % level.

Table (4) : Least squares analysis of variance of machine milk yield

Source of variance	d.f.	Mean squares	
		Morning	Evening
Parity	4	34.78 **	11.65**
Vacuum level	2	2.78 **	0.20 NS
Pulsation rate	1	6.30 **	0.01 NS
Pulsation system	1	12.47 **	7.47 **
Reg.on stage of lactation	1	85.73 **	51.38 **
Residual	447	0.69	0.36

NS Not significant

** Significant at the 1% level.

Table (5): Least squares means*of rate of milk flow (Kg./min)

Classification	N	Morning $\bar{X}$	Morning S.E.	Evening $\bar{X}$	Evening S.E.
Overall	457	0.95	0.01	0.79	0.01
Parity:					
1	136	0.85 a	0.02	0.72 a	0.02
2	49	1.07 b	0.04	0.84 b	0.04
3	83	0.98 bc	0.04	0.84 b	0.03
4	146	0.97 bc	0.03	0.78 ab	0.02
5	43	0.89 ac	0.04	0.77 ab	0.04
Vacuum level:					
35 cm.Hg.	142	0.78 a	0.03	0.68 a	0.03
40 cm.Hg.	155	1.02 b	0.02	0.84 b	0.02
50 cm.Hg.	160	1.06 b	0.02	0.84 b	0.02
Pulsation rate:					
50 cyc./min.	308	0.88 a	0.02	0.76 a	0.01
60 cyc./min.	149	1.03 b	0.02	0.82 b	0.02
Pulsation system:					
Simultaneous	208	0.94 a	0.02	0.75 a	0.02
Alternative	249	0.96 a	0.02	0.83 b	0.02
Reg.on stage of lactaion	457	- .0002	.0003	-.001	.0002

*Means not followed by same letter differ significantly at the 5% level.

Table (6): Least squares analysis of variance of rate of milk flow.

Source of variance	d.f.	Mean squares	
		Morning	Evening
Parity	4	0.51 **	0.24 **
Vacuum level	2	1.57 **	0.56 **
Pulsation rate	1	2.13 **	0.38 **
Pulsation system	1	0.01 NS	0.46 **
Reg.on stage of lactation	1	0.04 NS	1.10 **
Residual	447	0.06	0.05

NS not significant

** Significant at the 1% level

تأثير بعض العوامل الفسيولوجية والميكانيكية على صفات الحلب الآلى فى الجاموس المصرى

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أجريت هذه الدراسة على ٢٤ جاموسة من قطيع كلية الزراعة بجامعة القاهرة تمثل مواسم الوضع من الأول الى الخامس كما تمثل مراحل مختلفة من موسم الحلب .

أثر ترتيب الوضع معنويا على جميع صفات الحلب الآلى فيما عدا زمن التحنين صباحا ، كما كانت معاملات انحدار جميع صفات الحلب على كل من مرحلة الحليب وكمية اللبن معنوية على مستوى ١ ٪ (فيما عدا معاملى انحدار زمن التحنين ومعدل التدفق صباحا على مرحلة الحليب) .

أدى رفع مستوى الضغط السالب من ٣٥ الى ٤٠ سم زئبق الى خفض زمنى التحنين والحلب الآلى وزيادة معدل تدفق اللبن ، وأدت زيادة المستوى الى ٥٠ سم زئبق الى زيادة محصول اللبن صباحا . وأدت زيادة معدل النبض من ٥٠ الى ٦٠ دوره / دقيقة الى تخفيض زمن الحلب مساء وزيادة معدل تدفق اللبن وكمية اللبن . كما أدى استعمال النظام المتبادل للنبض الى زيادة محصول اللبن بحوالى ١٠ ٪ عما لو استعمل نظام الحلب المتزامن (وكانت جميع الفروق المذكورة معنوية احصائيا) وأكدت الدراسة امكانية الميكنة الكاملة لعملية الحلب فى الجاموس المصرى ، كما أوضحت ضرورة عمل التعديل المناسب لنظام النبض ومعدله ومستوى الضغط السالب لتحسين كفاءة الحليب الآلى للجاموس .

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