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TESTING AND PERFORMANCE EVALUATION OF AN IMPORTED MOBILE BUCKET MILKING MACHINE FOR WATER BUFFALOES

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ABSTRACT

An imported mobile bucket milking machine was used for milking water buffaloes. The experiment was conducted at Livestock Research Station (LRS), National Agricultural Research Centre, Islamabad. A herd of 12 animals (water buffaloes) were milked for more than one year. Machine milking of buffaloes was the first experience of its kind in Pakistan. The results were encouraging. Type and length of stimulation phase, size of teat cup liner, suited vacuum level, weight of milking cluster, milk capacity of claw piece, way of attachment of cluster and milking with single and double clusters were included as variables. The best suited size of teat cup liner for the milked animals was 25mm in diameter among the liners used. The 2.1kg cluster which was having light teat cup shells and stainless steel claw piece proved to be superior for the smooth and sponge like teats. The vacuum level 46-48kPa and 44-46kPa gave maximum milk yield (0.807 and 1.086 liters per minute) for single and double clusters, respectively.

Keywords: bucket milking machine, performance evaluation, buffaloes.

INTRODUCTION AND BACKGROUND

Historical background

Machine milking of cows and buffaloes have been recently introduced in the developing countries like Pakistan. These machines are now operating in the public/private dairy farms but still the majority of the farmers are using the traditional hand-milking. The history of machine milking in the developed countries like USA goes back over 100 years. The first vacuum type milking machine was patented by L.O. Colvin in 1865. In 1878, Mrs. Anne Baldwin came out with her Hygienic Glove Milker, an apparatus that used a hand pump to provide milking action. In 1892, the Mehring Milker, powered by a hand pump and later by foot power, began to gain acceptance as a practical aid in milking. In 1903, an Australian, Alexander Gillies, developed the first prototype for what was eventually to develop into the modern milking machine. This machine had a source of vacuum, a collection receptacle, pulsator, hoses, and individual teat cups and liners.

Modern milking machines

Modern milking machines are capable of milking cows and buffaloes quickly and efficiently without injuring the udder, if they are properly installed, maintained in excellent operating conditions and used properly. These machines perform two basic functions:

1. It opens the streak canal through the use of a partial vacuum allowing the milk to flow out of the teat cistern through a line to a receiving container; and
2. It massages the teat, which prevents congestion of blood and lymph in the teat.

Basically, there are two types of milking machines: (1) the bucket system, and (2) the pipeline system. In the bucket system the milk is received directly into a nearby vacuumized portable bucket, which may either be of two types (1) floor type, or (2) suspended type. Conventional pipeline systems use a rigid heat resistant glass or stainless sanitary pipe for carrying vacuum from the milk receiver to the individual milking units, and for carrying the milk from the units to the receiver. Pipeline milkers may be used any of the following types of facilities (1) Stanchion Barn, (2) Herringbone milking parlour, (3) Side-opening milking parlour, (4) Walk-through milking parlour, or (5) Rotary parlour. Regardless of make, the mechanical milking systems can be separated broadly into three major parts: (1) vacuum supply, (2) pulsation and (3) milking unit.

Vacuum Supply

The source of vacuum in a milking machine is a vacuum pump. Its function is to create a partial vacuum in the system by removing air from a confined space (the lines, teat cup liner, and reserve tank). These pumps are normally of the sliding vane type and are driven by electric motor. They require little maintenance and periodic checking of drive belt tension along with topping-up of the oil reservoir is usually sufficient. The pump should have sufficient capacity to be able to maintain a vacuum of 15 inches of mercury through out the milking period. This level of vacuum should be sustained even if a unit is kicked off by a cow or as unit are fitted or removed from the animal. It is generally recommended that the pump be of sufficient size to displace at least 25% more air than is required to operate the milking units and to lift and transport the milk to the cooling and storage area if a pipeline system is used. This additional displacement allows for efficiency as the pump wears with age. Excess capacity is controlled by vacuum regulator.

Pulsation

Pulsators are installed in milking systems to direct the air flow leading to and from the milking unit.

Pulsators may be of the unit type (One at each milking unit) or the master type (One for more than one unit). Two types of Pulsator are mostly used: (1) pneumatically controlled pulsators and (2) electrically controlled pulsators. Pneumatic pulsators have a locking-screw valve which allows the milker to adjust the pulsation rate. Electric pulsators utilize a timing device to regulate pulsation rate.

Milking unit or cluster

The purpose of the milking unit is to remove the milk from the teat to the milk receptacle or pipeline and to massage the teat. Each milking unit has four individual teat cups. Each teat cup has two chambers. These chambers are formed by fitting a rubber inflation tube (Liner) inside the shell (a cylindrical rigid part of the teat cup, generally made of stainless steel). The chamber which is formed between the wall of the inflation tube and the teat cup shell is connected to a pulsator which alternately removes and admits air. The alternate supply of vacuum/air is known as the pulsation rate and occurs about 60 times/min. The inner chamber is under continuous negative pressure during milking.

During the milking phase, partial vacuum is present between the shell and the liner. The liner assumes its normal shape and the vacuum in side the liner opens the streak canal and withdraws the milk. During the rest phase, atmospheric air is admitted into the space between the liner and the shell. The liner collapses around the teat. This massaging action promotes circulation in the teat and allows the teat a brief moment of rest. If the massage phase is too short and the milking phase too long, circulation is impaired, and the teat becomes injured due to congestion. The relationship between vacuum/air or MILK: REST is called the pulsation ratio which is normally 3:1.

Vacuum level, pulsation rate, and pulsation ratio vary among brands of milking machines. Each manufacturer recommends the combination of vacuum level, pulsation rate, and pulsation ratio that works best for that brand of milking machine. These recommendations should be followed if one expects the machine to do its job efficiently without damaging the teats or causing discomfort to the milk animal.

MATERIAL AND METHODS

Two units of mobile bucket milking machines were imported from M/s Westfalia Separator, Germany for test and trial purpose on water buffaloes. These machines were originally meant for cows milking. The physical structure and different parts of this machine are shown in Figures 1 and 2. This unit consisted of a frame, dry operating vacuum pump with flanged electric motor, vacuum hose, moisture trap, vacuum gauge, vacuum control valve, a pulsator, milking clusters and milking bucket. The machine is driven by a single phase motor of 1 hp. The rate of air flow of the vacuum pump is 140 litres per minute. The machine is double cluster i.e. two animals can be milked at a time.

Figure-1. Mobile Bucket Milking Machine.

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Pneumatic pulsator

Vacuum pump coupled with electric motor

Vacuum gauge and control valve

Milking unit or cluster

Milk and air hoses

Moisture trap

Figure-2. Different parts of mobile bucket milking machine.

A herd of 12 animals (water buffaloes) were selected for machine milking. The experiment was setup at the barn of the Livestock Research Station (LRS), National Agricultural Research Centre, Islamabad. Machine milking of buffaloes is interplay between man, animal and machine. Many variants have to be decided during physical and experimental observations. Table-1 shows such variants.

Table-1. Selection of appropriate variant for efficient and gentle milking.

Variants	**Selection decisions?**
Size of teat cup liners	Dia. 19mm, 23mm, 25mm and 27mm
Vacuum level	Ranges from 40-50 kPa
Type and length of stimulation phase	Conventional or European. Time in minutes
Weight of milking cluster	Ranges from 1.5-3.5kg
Milk capacity of claw piece	200 cm^3 or 300 cm^3
Way to attach milking unit	From the side of animal or from the hind legs
Milking with one or two milking cluster per bucket	Requirement of dairy farmer and capacity of machine

The following methodology was adopted:

- A herd of 12 buffaloes will be machine milked for full lactation period;
- Suitable sizes of teat cup liners will be determined among the available liners of 19, 23, 25 and 27 mm in diameters;
- Suitable weight of the milking cluster will be determined among the available clusters of 1.8, 2.1 and 2.6kg;
- Milking will be performed two times in a day (Morning and Evening) with even milking gap. The instantaneous increase in milk weight will be measured with time;
- Milking with one and or two clusters per bucket will be performed. Milking will be made on different vacuum levels. The most appropriate vacuum level will be determined;
- Any changes occurring in the teats after milking will be examined; and
- Alternate washing of the machine will be performed with an alcalic rinsing agent in the morning and an acidic rinsing agent in the evening.

RESULTS AND DISCUSSIONS

The milk buffaloes of this study in the beginning of the experiment were much nervous and shy due to unfamiliar milker and noise of the machine pump.

However, the animals used to machine milking after 4-5 milking. The response of buffaloes to machine milking with different variables is summarized as under:

Size of teat cup liners for water buffaloes

The best suited size of teat cup liner for the milked animals was 25mm in diameter among the liners used (19mm, 23mm, 25mm and 27mm). All test buffaloes with long and short teats could be milked extremely well using this liner. The 25mm dia. liner was used throughout the experiment period.

Vacuum level

Different vacuum levels were set for single and double clusters using vacuum control valve. The pulsation ratio and pulsation rate of the pneumatic pulsator was 60:40% and 60 per minute, respectively. The vacuum level 46-48kPa and 44-46kPa gave maximum milk yield (0.807 and 1.086 liters per minute) for single and double clusters, respectively (Table-2).

Type and length of stimulation phase

The milk let down was achieved by stimulating teats for two minutes and stripping the first jets into the buffalo's mouth.

Weight of milking cluster

The weight of the milking cluster has decisive influence on the milking results. Three different clusters weighing 1.8, 2.1 and 2.6kg were used. The 1.8kg cluster was having light teat cup shell and plastic claw piece. The disadvantage of this cluster was that the liners climbed up the teat contraction, resulting in long milking time and low milk output. The 2.1kg cluster was having light teat cup shells and stainless steel claw piece. This cluster proved to be superior for the smooth and sponge like teats. The 2.6kg cluster had normal teat cup shell and stainless steel claw piece. The problem faced was its adhesion and stretching.

Milk capacity of claw piece

The claw piece having volume of 300 cm^3 gave the best results.

Way to attach milking unit

All the animals were milked from the side of the animals.

Milking with one or two milking cluster per bucket

This depends on the requirements of dairy farmer and the capacity of machine. During this experiment the animals were milked using single and double clusters.

Table-2. Selection of appropriate vacuum level using single and double cluster milking.

Nature of milking	**Vacuum level (Pressure)** (kPa)	**Average milk yield per minute** (Liters/minute)
Single cluster	42-44	0.711
	43-45	0.786
	44-46	0.792
	46-48	0.807
	47-49	0.724
Double cluster	41-43	
	41-43	0.726
	42-44	0.927
	43-45	0.964
	44-46	1.086
	45-47	0.981

Machine milking of buffalo.

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