Lactation

Dr. Ahmed Dawod

Factors Affecting Milk Yield

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Genetic factors

Genetic difference

- Heritability is defined as the ratio of genetic variance to total phenotypic ratio. The concentrations (%) of the three major milk constituents are genetically controlled to a considerable extent. Heritiabilities of fat, protein, and lactose contents average 0.58, 0.49, and 0.50, respectively, while that of milk yield average 0.27. Some milk constituents are strongly correlated

Breed

Holstein cow has the highest volume of milk production (12000 L/ season) with low fat content (3.5%)

Guernsey has the higher milk fat % (6%)

- Holstein have white color milk (have carotenaisis enzymes), while Jersey and Guernsey have yellow milk color

Milking speed

- It is the period of time required for complete milking of the cow
- The cows differed between each others in the milking speed according to their genetics (fast milking cows, slow milking cows)
- The milk production is direct proportion to the milking speed
- Wide steak canal lead to fast milking
- Fast milking cows have low complementary milk which increase the milk yield

Physiological factors

Cow age and size

- The milk production increase till the cow reached the age of 8 years then it declined
- Increasing of the dairy cow size resulted increasing of the milk yield and vise versa

Lactation number (parity number)

- Milk production increases with increase of the lactation number till reach the fifth lactation then it decline thereafter.
- This is a result of the increasing development and size of the udder and the increasing body size over that of the first lactation animal.

Estrus

- Estrus decrease the milk production this is because the main effecting hormone is the estrogen. Estrogen high level during estrus day decease the milk production
- Cystic anestrus cows produced milk more than cystic nymphomaniac cows

Pregnancy

- Pregnancy has an inhibitory effect on milk yield.
- Pregnant cows have high rate of decline in milk production that it reached 20%
- Sharp decrease in milk yield occurs at the 8^{th} month of pregnancy
- This decrease attributed to the increase in estrogen and progesterone level as pregnancy progresses, which inhibits milk secretion as well as the high fetal growth.

Environmental factors

Ambient temperature

- The effect of ambient temperature on milk yield is dependent upon the breed.
- Holsteins and the other larger breeds are more tolerant to lower temperatures, whereas the smaller breeds particularly the Jersey, are much more tolerant to high temperatures.
- The optimum temperature for the Holstein cow is about 10°C.
- Cow suffered from heat stress at 24°C
- At 27°C the milk yield dropped by 10%
- At 32 C the milk yield dropped by 35%

Disease

- Diseases decrease the milk yield
- Permanent loss (chronic mastitis, mastitis)
- Temporary loss (feverage diseases and metabolic diseases).

Management Factors

Feed and water supply

- Any restriction in feed or water supply will result in a drop in milk production.
- Protein deficiency results in flat lactation curve and the dairy cows can not reach the peak of the curve
- Energy deficiency resulted in sharp drop in milk production specially after the peak

BCS and body weight at calving

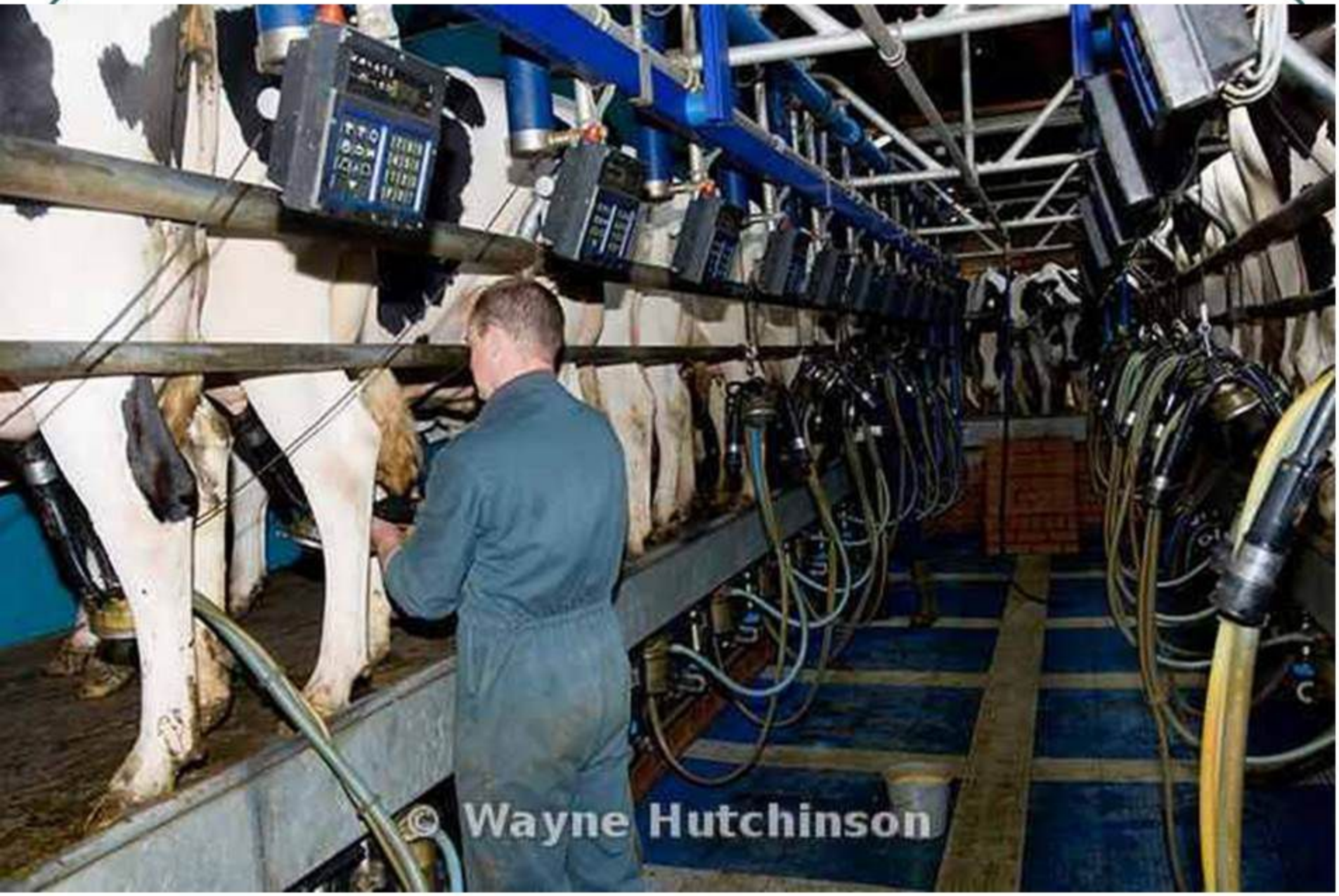
- Increasing of BCS during prepartum period results in increasing of the milk yield, while low BCS leads to low milk yield
- look like BCS. Decreasing of the weight than the optimum weight by 50 kg at calving results in crossponding loss in milk yield by 750 Kg in the succeeding lactation phase
- The ideal BCS is 3.5± 0.25 at calving
- Body weight is not likely to affect the milk production, but it affect the composition

Season of calving

- Cows calving in late fall to spring produce more milk (up to 8% more) than cows calving in the summer.
- This is likely due to an interaction between day light and ambient temperature.
- Seasonal differences have become less significant because of better feeding and management of the dairy cow.

Milk ejection reflex

- Cows must be milked within 2 minutes from initiation of milk yield reflex because the effect of oxytocin will lasts within 5 minutes
- Stressors or delaying in milking process will interfere with the efficient milking process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Rate of Milk Secretion

- The period following milk removal is characterized by low intra-alveolar pressure, which facilitate the transport of newly synthesized milk into the alveolar lumen. As secretion continues between milkings, pressure is exerted on the secretory process by the alveolar luminal contents. When the luminal pressure exceeds the force of secretion as the alveolar enlargement reaches its limit. It is presumed that the distention pressure of the lumen exceeds the strength of the secretory mechanism needed to push the newly formed milk out of the cell. In turn, the buildup of newly formed milk in the cell retards the uptake of milk precursors by chemical feedback mechanism (e.g. FIL) and / or physical factors (e.g. intra-mammary pressure).

Duration of milking

- Milking time should be above 5 minutes
- Decreasing of milking time under 4 minutes resulting in incomplete milking
- Incomplete milking resulted in decreasing of milk production which may be permanent loss

Milking intervals

- Cows are usually milked at equal intervals (12-h interval for 2 x milking). Cows milked at unequal intervals produce less milk than those milked at equal intervals. The reduction in milk yield is more in high producing cows than in low producing ones.

Milking intervals

- For 2X/day milking of dairy cattle, the optimum interval is 12 hr
- 10-14 hr result in a decline in milk by 1%
- 9 and15 hr interval results in 1.8% less milk yield,
- 8 and 16 hr interval results in 3.4% less milk.

Milking frequency

- Milking a twice a day yields at least 40% more milk than once a day.
- Increasing milking frequency to 3 x day increases milk yield by up to 25%
- 4X increase milk by 5-15% The most likely reasons for increased milk production as frequency of milking increases are 1) less intramammary pressure generated with frequent milking, 2) increased stimulation of hormone activity favorable of milk production and 3) less negative feedback on the secretory cells due to the accumulation of milk components (feedback inhibitory protein)


Ronald de Hommel photography

Dry period

- the dry period less than 40 days resulted in 25-40% less milk compared with 40-60days.
- Dry period longer than 60 days resulted decrease the life long milk production that the animal must be have 12 month calving intervals.

- Part of the dry period effect is related to body condition of the cow at calving. Cows in good body condition at calving produce higher milk yield during the following lactation than in cows in thin body condition at calving.

Exercise

- Moderate exercise is conducive to high milk production. Too much or too little is detrimental. Cows in stanchion barns should be turned out at least once per day for exercise and heat detection.

Drugs

- Corticosteroids have an inhibitory effected on the milk yield
- Antibiotic no effect but it will descend in the milk -------leads to discarding the milk)
- Estrogen and progesterone drugs decrease the milk yield

Growth hormone (BST or rBST)

- Injection of BST in the dairy cattle resulted in subsequent increase the milk production by 25%
- It is approved in USA to be used in the dairy herds as milk inducing strategies
- Repeated doses must be followed otherwise a sharp decline in the production occurred

Growth hormone (BST or rBST)

- Growth hormone resemble prolactin hormone in its structure and functions
- Bovine somatotropin hormone manufactured via gene recombination so it is termed recombinant bovine somatotropin (rBST) within the E.coli bacterial cells
- The milk produced from the rBST treated cows is topically similar to the milk of the non treated ones
- The hormone improve the feeding ability of the dairy cows and improve their carcass characteristics

Thyroid hormones

- Injection of the cow with the tri-iodothronin results in increasing of the milk production by 25%