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Research Article

The Effect of Cane molasses on Cow Milk Productivity

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Abstract

In the current scenario due to increased input costs, commercial dairy operations are seeking reduced-cost feed alternatives to enhance productivity while reducing feed costs. The organic dairy sector has had recent unprecedented changes in their industry due to increased grain prices. Therefore, organic dairy farmers in particular are seeking lower-cost energy alternatives. Sugar cane molasses, a rich source of sucrose, seems to be a viable option as a source of energy and minerals. Globally, many studies had indicated the positive effect of supplementing cane molasses in dietary feed plans for dairy cows. However, little research exists evaluating the effects of cane molasses on cow milk productivity and its co-relation with environmental conditions. Also, evaluation on a case-by-case basis to determine feasibility of cane molasses as an energy source for dairy cows is the need of the day. Thus, the present studies was conducted wherein cane molasses feed was introduced as a component of a total mixed ration containing appropriate amounts of silage, concentrates and mineral mixes in the basic feed plan practiced at our dairy farms and cow milk production data was recorded for a total of 108 days. Moreover, the Temperature-Humidity Index (THI) was also measured in order to evaluate the environmental effect on cows fed with cane molasses. The trials indicated a significant interactions between cane molasses supplementation rate, environmental conditions and milk productivity of cows under observation. It was observed that cows fed with cane molasses resulted in a decrease in their milk productivity. This is in contrast to previous findings in this context. It is implicated that cane molasses quality, over-feeding and also other environmental factors may had a possible effect on the milk productivity of cows during the conducted trials. It is envisaged that molasses may need to be evaluated on several complicated parameters like cost and availability of molasses, timing of supplementation, source of molasses, the manufacturing practices of molasses, ease of feeding, lactation stage of the cows, body condition scores of cows and the affecting environmental parameters, in order to determine whether or not it may be a feasible component of feed plans for dairy cows.

Keywords: *Molasses, dairy cow, milk yield, milk productivity*

1. Introduction

Cane molasses has been used as feed for livestocks for many years. Generally, cane molasses is in dry or liquid form and is practical source of dietary sugars for feeding to dairy cows (Hall M. B. *et al.*, 2002). Cane molasses is a rich source of sucrose, seems to be a viable option as a source of energy and minerals. Cane molasses often costs less per day to feed than organic corn, is energy dense, is extremely palatable and is available in organic form and so could be used in all sectors of the industry (Morales J. L. *et al.*, 1989). Cane molasses is categorized as concentrate. Ideally, a concentrate is that feed component which supplies primary nutrients (protein, carbohydrate and fat) at higher level but contains less than 18% crude fibre with low moisture. In general, concentrates are feeds that are high in nitrogen free extract and Total Digestible Nutrients (TDN) and low in Crude Fibre (CF). On the basis of the Crude Protein (CP) content of air dry concentrates, these are classified as either energy rich concentrates when CP is less than 18% or protein rich concentrates when the CP value exceeds 18%. In India, mainly there are three types of indigeneous molasses i.e., cane molasses, beet molasses and citrus molasses. The cane molasses is a type of energy rich concentrate from plant source i.e., sugarcane. It is often included in a ration to improve its palatability, improve rumen microbial activity, increase microbial protein synthesis. Thus, it can facilitate the reduction of dustiness in the ration or act as a binder for pelleting (Perry T.W. *et al.*, 1999)

Since long worldwide attempts have been made to analyse the effect of cane molasses as cattle feeds. Previous studies on the effect of cane molasses on the digestibality of a complete ration fed to dairy cows had indicated that the digestibility of the CF, the nitrogen free extract and the ether extract was not uniformly affected in either direction by the presence of molasses in the ration and also molasses tends to depress the digestibility of crude protein and dry matter (P. S. Williams, 1925). However, supplementation of Urea-molasses (UM) in dairy rations have shown positive effects on the performance of ruminants in many different countries

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(Leng R.A. *et al.,* 1984; Sansoucy R. G. *et al.,* 1995; Chenost M. *et al.,* 1997; Plaizer J.C.B. *et al.,* 1999; Thu. N.V. *et al.,* 2000). Moreover, the effect of UM-straw on the productive and reproductive performance of indeginious cows under the village conditions of Bangladesh had suggested that UM-straw can be fed for improving the said performances (M. S. Hossain *et al.*, 2002). Another study in the same year had also shown the beneficiary effect of feeding UM treated straw on bufallo cows in Bangladesh (M.J. Uddin *et al.,* 2002). Also, the studies on effect of UM multinutrient block on the reproductive performance of indigeneous cows had suggested its positive effect on fertility under the village conditions of Bangladesh (M.A.Mazed *et al.,* 2004). However, studies to analyse the effect of UM on the nutritive value of roughage based ration incubated in Buffaloe rumen liquor had suggested that no interaction effects between urea and molasses on the digestibility of the diets (M.R. Mashayekhi *et al.,* 2007). Furthermore, the analysis of molasses supplementation and nutritive value on ruminal fermentation of a pasture-based diet had indicated no significant interactions between forage nutritive value and molasses supplementation rate related to ruminal fermentation (K. J. Soder *et al.,* 2011). However, dietary molasses can increase ruminal pH and enhance ruminal biohydrogenation during milk fat depression (C. A. Martel *et al.,* 2011).

Studies have documented that molasses supplementation to the diet improves production in dairy cows but over-feeding more than 6 % total sugar can depress production (G. A. Broderick *et al.,* 2004). The addition of extra molasses to a texturized calf starter may result in a decreased intake and structural growth, possibly causing decreased weight gain, in neonatal dairy calves. However, it can increase blood volatile fatty acid concentrations and can slightly increase ruminal development (K. E. Lesmeister *et al.,* 2005). Excessive molasses in diets can act as a possible cause of an “endocrine disruptive syndrome” in calves (M.S. Masgoret *et al.,* 2009). This Syndrome is a relatively new concept in toxicology that has been well described in humans and in a variety of wildlife species (Colborn T. *et al.,* 1993; Lamb J.C. *et al.,* 1996; Guillette L.J. Jr. *et al.,* 2000a; Guillette L.J. Jr. *et al* 2000b), but never before in cattle. Although unidentified in cattle, it has been predicted that, should it ever occur in cattle, it would be characterized by infertility and immunosuppression (Rhind S.M. *et al.,* 2002). Many researchers have claimed that molasses has the ability to deplete copper reserves that is attributed to its high sulphur content (Beames R.M. *et al.,* 1959); Arthington J.D. *et al.,* 2002) and can result in a condition known as “molasses toxicity” (McDonald P. *et al.,* 1995). Researchers had also reported a depressed intakes of ration by cows when high quality forage diets and high concentrate diets were fed separately, wherein molasses was included in these rations (Lofgreen G. P. *et al.,* 1960; Komkris T. R. *et al.,* 1965; Morales J. L. *et al.,* 1989). These efforts indicate that diet quality influences intake alterations as molasses has a greater impact on digestibility of low-quality forages compared to higher quality forages (Titgemeyer E. C. *et al.*, 2004). Researhers had indicated that when poor quality forages and molasses is supplemented at 9.7 or 19% of total dry matter intake, it will reduce fiber digestibility, possibly because ruminal bacteria utilize the easily-digested soluble sugars in molasses in preference to the less available fibrous material of the forage (Davis R. F. *et al.,* 1955). However, appropriate amounts of dietary rumen degradable protein may prevent sucrose from depressing neutral detergent fiber digestibility (Lee M. R. F. *et al.,* 2003) as has been noted in some studies with lower-quality forages (Khalili H. *et al.,* 1991; Heldt J. S. *et al.,* 1999). The reason for this is that the relatively high rumen degradable protein can increase the levels of ammonia (Kolver E. S. *et al.,* 1998) as well as pre-formed amino acids and peptides that can be used as substrates for cellulolytic bacterial growth (Poppi D. P. *et al.,* 1995; Atasoglu C. *et al.,* 2001) to maintain fiber digestibility.

Researchers have also claimed that sugar based products like cane molasses in dairy cattle rations can change ruminal fermentation patterns that may decrease ruminal NH_3 concentration (G. A. Broderick *et al.,* 2004; DeFrain J. M. *et al.,* 2006) and can increase ruminal butyrate concentration (Hristov A. N. *et al.,* 2003) as it will undergo rapid fermentation in the rumen, theoretically leading to lactic acid production and thereby decreasing ruminal pH that potentially could depress fiber digestibility (Oelker E. R., *et al.,* 2009). In order to improve fiber digestibility high-moisture corn can be replaced with molasses (G. A. Broderick *et al.,* 2004) that can have a stimulatory effect on fiber-digesting ruminal bacteria primarily responsible for ruminal biohydrogenation of fatty acids (Harfoot C. G. *et al.,* 1997). Thus, it can be inferred that dietary molasses may be capable of enhancing biohydrogenation of unsaturated fatty acids and can eliminate the potential negative effects on milk fat synthesis. This is so as cane molasses will result in the complete biohydrogenation of unsaturated fatty acids, therefore, it will prevent diet-induced milk fat depression. Recently, studies on the effect of molasses supplementation on performance of lactating cows fed high-alfalfa silage diet have shown that addition of dried molasses increased milk urea nitrogen but had no effect on animal performance (B. Baurhoo *et al.,* 2014). Also, exchanging molasses-based products for corn in dietary dry matter have not influenced productivity and have shown minute effects on milk fatty acid profile (A. Siverson *et al.,* 2014). Thus, as per the prior art search done there is a lack of research that has evaluated the effect of cane emolasses supplementation rate in dairy rations on cow milk productivity and its co-relation with environmental conditions. Therefore, the objective of present work was to determine the effect of using cane molasses as cattle feeds and the effect of environmental conditions on cow milk productivity at our dairy farms.

2. Materials and Methods

Cane Molasses type termed as '*Kakab*' in local context obtained from a local trader was used as cattle feed for a total number of 34 cows for 33 days (April-2014 to May-2014), total 35 cows for next 14 days (May 2014), total 38 cows for next 2 days (June 2014), total 40 cows for next 8 days (June 2014), total 43 cows for next 17 days (June 2014), total 47 cows for next 22 days (June-July 2014) and finally a total 49 cows for the next 10 days (July 2014) at our dairy farms. All the selected cows of control and research groups were second-lactation Holstein cows (550 ± 52 kg BW) that were housed in freestyle barns and had continuous access to water. Total mixed rations were fed twice daily throughout the experiment. All the cows were in fair to good conditions at the beginning of the experiment and remained so throughout the trials. When a cow refused any part of her daily feed she was immediately removed from the experiment until such time as she consumed the regular ration and then she was not included in any trial unless she had received the ration without change in amounts for at least a week previous to the beginning of the trial. Exclusive guidelines were framed for research purpose by the company's authority wherein necessary measures were taken to curtail the pain or distress to cattles. The basic feed plan (April 2014) comprised of a total mixed ration containing appropriate amounts of silage, concentrates and mineral mixes in which the cane molasses feed was introduced as a component.

Initially, for 7 days the cows under the trails were separated, and kept under normal basic feed plan. Then with a initial concentration of 0.38 Kgs, cane molasses was introduced on the 8th day of the trial. Thereafter, the cows were fed with 0.75 Kgs for next 6 days, 0.76 Kgs for next 3 days, 0.81 Kgs for next 3 days, 0.79 Kgs for next 2 days, 0.78 kgs for next 10 days, 0.79 Kgs for next 1 day, 0.77 Kgs for next 9 days, 0.51 Kgs for next 19 days, 0.58 Kgs for next 16 days, 0.61 kgs for next day, 0.41, 0.31, 0.21 for next single consecutive days followed by 0.10 Kgs for the next 17 days, and then without cane molasses for the next 9 days under observation. All other feed components were kept constant during the trials. In order to evaluate the environmental effect on cows fed with cane molasses on its milk productivity, the Temperature-Humidity Index (THI) was measuerd using a THI-meter during the trial period. The data of this study were statistically analyzed using Origin Labs software version 9.1 (OriginLab Corporation, Northampton, USA).

3. Results

The change in concentration of cane molasses and its simultaneous effect on milk production for total 108 days was recorded for the present studies. It was observed that cane molasses concentration of 0.75 Kgs gave maximum milk productivity of 18.29 litres (April, 2014) of average milk, while concentration of 0.51 Kgs cane molasses gave minimum milk productivity of 14.72 litres (June, 2014) of average milk. The graphical representation of the change in cane molasses concentration and simultaneous milk productivity is depicted in figure 1. Moreover, the THI recorded during the trial period is depicted in the figure 2.

4. Discussion

The previous data of average milk productivity before the initiation of the present trials suggest high milk production in comparision to molasses fed diet at our dairy farms. It was observed that there was an initial decrease in milk production when cane molasses was introduced in feed plan. Thus, adoption of cane molasses as a feed component resulted in lower milk productivity.

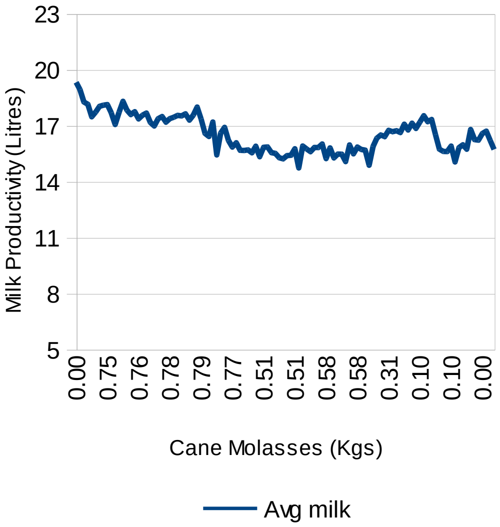

Figure 1: Cane Molasses concentration and simultaneous milk production

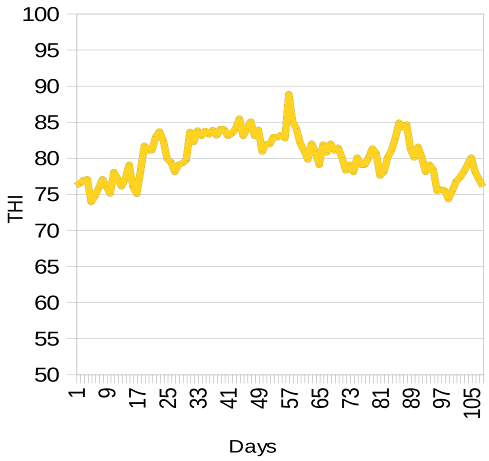

Figure 2: THI recorded during the trials

After the onset of the trials the milk productivity remained near 17 liters between 0.75-0.80 Kgs of cane molasses concentration. Thus, this range of cane molasses concentration can be considered optimum for a steady productivity. Thereafter, further reduction of molasses concentration in the range of 0.50-0.60 Kgs resulted in a further decrease in productivity and remained steady around 15 litres average milk. During, the last phase of the trials when the cane molasses concentration was further reduced to the minimum there was a increase in the milk productivity around 17 litres of average milk. Lastly, improvement in productivity was observed after completely stopping the cane molasses feed. Moreover, as per the THI recorded it is suggested that environmental conditions can have a possible effect on the cow milk productivity. It is interpreted from the present studies that overfeeding of cane molasses i.e., sugars appeared to be the main reason that reduced our cattle performance and hence a decrease in milk production was observed. High sugar levels had decreased ruminal fiber digestion capacity. Moreover, its supplementation had altered nitrogen utilization and microbial protein synthesis patterns that may be responsible for changes in milk production. The energy in molasses was used to “unlock” the protein in the fiber component. In turn, the protein from the fiber could be used as either energy or protein, therefore additional energy from molasses was not beneficial. Thus, it is recommended that effective fiber and rumen degradable protein must be available in rations for dairy cattle before adding sugars and the possible detrimental effects of too much sugar in the rumen must be considered before implementeing cane molasses as cattle feeds. Moreover, the results of the present study indicates significant interactions between cane molasses supplementation rate, environmental conditions and cow milk productivity. This is in contrast to previous findings as discuused earlier. However, those studies were conducted with much different feeding regimes and had different environmental conditions than those prevelant during the present study. Thus, several complicating factors must be considered by dairy farmers when supplementing cows with molasses. These include items such as cost and availability of molasses, timing of supplementation, source of molasses, the manufacturing practices of molasses, ease of feeding, lactation stage of the cows, body condition scores of cows and the affecting environmental parameters.

Conclusions

During the present studies, introduction of cane molasses in the basic feed plan at our dairy farms resulted in a decrease in milk productivity of our cows. This may be due to cane molasses quality and also other environmental factors may have an effect on the yield. It is also envisaged that overfeeding of cane molasses appeared to be the main reason that reduced our cattle performance and hence a decrease in milk production was observed. Therefore, although cane molasses can be a good source of energy, the present studies suggest its possible negative effect on cow milk productivity. Therefore, it is implicated that molasses may need to be evaluated on a case-by-case basis to determine whether or not it may be a feasible cattle feed component.

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