CHAPTER V

DISCUSSION

Dry matter intake and water intake

A number of studies have been shown the positive effects of Na supplementation from different sources of DMI in lactating cows. Supplementation of 1% $NaHCO_3$ in the diets increased DMI for 12.1%, when compared with unsupplemented diet (Vicini et al., 1988). In addition, increasing of high level of $NaHCO_3$ could also enhance feed intake. At the level of 1.90% of $NaHCO_3$ in the diet, which has given 0.87% of dietary Na, increased 0.8 kg of DMI and 0.17% of DMI/%BW when compared to 0.53% of dietary Na (West et al., 1992). In these present results, supplementation of Na_2CO_3 in diet had significant effects on DMI and DMI/%BW ($P<0.05$) in crossbred Friesian cows in mid lactation, when the Na content of the TMR dietary was increased from 0.17% to either 0.58% or 0.96% DM by the supplementation of 0%, 1% and 2% Na_2CO_3, respectively.

In contrast to many studies which have shown that TMR dietary containing 1.2% $NaHCO_3$ could not increase in DMI in comparison to unsupplemented diet (Rogers et al., 1985). The study by Arambel et al. (1988) observed that the addition of 0.28% NaCl to TMR diets compare with 0.28% NaCl plus 0.4% $NaHCO_3$ (Na = 0.26% and 0.48%), containing long-stemmed alfafa hay as the sole forage, had no effect on BW and DMI . Newbold et al. (1989) also reported that the supplementation of $NaHCO_3$ at the level of 660 g/kg DM to the diets containing grass silage and molasses had no effect on DMI in primiparous cows in early lactation. Adding of 1.5% $NaHCO_3$ in TMR, which increased the Na level from 0.26% in basal diet to 0.73% Na in supplemented diet, no increase in DMI was also noted by Tucker et al. (1992). Belibasakis and Triantos (1991) fed animal by TMR containing either 0% or 0.78% Na_2CO_3 (as fed) which had dietary Na 0.13% and 0.46% DM, respectively. No differences were found in DMI between each diet in early lactating cows.

In the present study, Na supplementation at 1% and 2% in the form of Na_2CO_3 increased significantly (P<0.05) of DMI. An elevation of dietary Na_2CO_3 had been shown to improve DMI and DMI/%BW by 0.44-9.23% and 12.81-13.52%, respectively. It will support the recommendation of NRC (2001), which lactating cows generally need at least 0.2% of Na in the diet animals get into heat stressed condition, Na requirement will be increased. The Na level of 0.5-0.6% in the diet is recommended to use during heat stress (Beede, 1994). The dairy cattle in Thailand usually are in heat stress condition for the whole year during exposure to the high ambient temperature and high relative humidity. The deleterious effect from heat stress in crossbred Holstein cows has been shown in reduction in feed intake (Umpapol, 2001). Therefore the level of Na used in the diet in this study, which were 0.58% and 0.96%, may be recommended to include in the diet for lactating cows. It indicates from the present study that Na supplementation in form of Na_2CO_3 could enhance feed intake of multiparous crossbred Friesian cows during mid lactating period.

However, there were no differences in the values of WI and WI/DMI ratio in the present results. Although it has been found that water intake of multiparous lactating cows, during 12 hours observation, was increased when intraruminal infusion of 273.6 mg/min of $NaHCO_3$ was performed. Total percentage of Na receiving from infusion and diet were 1.59% (Oba and Allen, 2003). It is probably that Na supplementations in form of Na_2CO_3 would not affect to increase in the rumen osmolality for induction in water intake.

Milk production and compositions

In the present results, MY was significant increased (P<0.05), while 4%FCM, the production and the concentrations of TS, fat, SNF, protein, lactose, Na, K, and Cl were not affected by increasing Na_2CO_3 dietary. However, the yield of TS, fat, SNF, protein, lactose, and the concentrations of Na and Cl tended to increase, while the concentration of K decreased when increased dietary Na. Similar results have been reported by West et al. (1992) that increases in $NaHCO_3$ in TMR from 0.98% to 1.90% with increase in dietary Na from 0.53% to 0.87% DM, respectively, had no effect on 3.5%FCM, milk fat and milk protein concentrations. Rogers et al. (1985) also reported that the milk fat concentration was unaffected by the addition of $NaHCO_3$ to TMR dietary, in which Na content in TMR diet increased from 0.20% to 0.52% (as 0% and 1.2% $NaHCO_3$ form).

In contrast to the observation by Belibasakis and Triantos (1991) that marked increases in 4%FCM, fat yield, TS, and milk fat concentration were apparent in cow fed TMR containing 0.78% Na_2CO_3 in the diet when compared with the control diet. In agreement with the findings of the present study, Schneider et al. (1984) found that low concentrations of Na (0.18% DM) limited FCM yield. Although diets using in the present study were not equalized in carbonate content, they were not affected to milk fat depressive (overall MF% = 3.46-3.55%).These result were supported the suggestion of Schneider et al. (1984) that lactational response to Na might be due partly to Na moiety per se and not entirely to buffering effects. However, increasing dietary Na_2CO_3 in the present study tended to improve (*P*>0.05) concentrations of lactose and SNF by 1.09-2.19% and 0.78-2.12%, respectively.

Sodium ion has been known to require for the absorption of glucose, galactose, most of the peptides and amino acids from the gastro-intestinal tract (Hays and Swenson, 1993). Sodium uptake from the gut lumen is achieved by coupling to glucose, amino acid, and volatile fatty acid (Henry, 1995; Harper et al., 1997). For this reason, an increase in dietary Na would affect to increase milk production and compositions. It is probably that Na^+ uptake by the mammary cell would couple with glucose transport into cell for lactose biosynthesis. Although the differences of milk lactose concentration among three groups were not significantly different, but mostly tended to increase in animals given high Na in diets.

Plasma electrolytes

The effects of the addition of Na in different types and forms of compounds to diets on the concentrations of plasma electrolytes have been reported in conflicting data. Kilmer et al. (1980) found that the concentration of plasma Na was not affected by increasing of $NaHCO_3$ dietary. Arambel et al. (1988) reported that no changes in plasma Na and K concentrations were observed when 0.8% of $NaHCO_3$ was supplemented in TMR diet. (Na = 0.26 and 0.48%) West et al. (1992) studied on the effects of low, high and very high level of $NaHCO_3$ supplementation (0.07%, 0.98%, and 1.9% $NaHCO_3$) in TMR diet (Na = 0.31%, 0.53%, and 0.87%), which no changes in the plasma concentrations of Na and K were apparent. Belibasakis and Triantos (1991) also observed that the addition of 0.78% Na_2CO_3 did not affect plasma Na and K concentrations. In contrast to the study by Nestor et al. (1988) that a decline in plasma K concentration was apparent as increased in plasma Na concentration. However, an increase in the concentration of K in plasma of cows feeding with high Na in diet (from NaCl and $NaHCO_3$) were also reported, but it did not affect to the plasma Na concentration (Sanchez et al., 1994; O'Connor et al., 1988; and Escobosa et al., 1984). The plasma Na concentration would increase when $NaHCO_3$ was used to increase dietary Na from 0.18% to 0.88% DM (Schneider et al., 1986). However, no increase was seen when NaCl was utilized as the Na source. In the present study, plasma Na, K, and Cl concentrations were not affected by supplementation of Na_2CO_3. An average of plasma Na level of animals consumed each diet was 137 mmol/l, which was closed to normal range of the value of the plasma Na concentration at 135-145 mmol/l (Tilak, 1998).

Urinary and fecal electrolytes excretion

In the present study, the ratio of Na:creatinine in urine was used to evaluate an excretion of Na in urine during Na supplementation in the diet. The present results for an increase in urinary Na:cratinine ratio in animals given high Na in diet, indicate that Na in body was mainly excreted via urine by approximately 62% (P>0.05) which was higher than that of excretion in milk by approximately 21% during increased dietary Na_2CO_3. Urinary K:creatinine ratio was affected (P<0.05) by inclusion of dietary Na_2CO_3. The ratio of K:creatinine was used to evaluate the rate of urinary K secretion. When this ratio was increased, it means that the rate of K^+ secretion in urine is increased. This result was similar to the study of West et al. (1992) for an increase in urinary Na:creatinine ratio when the Na concentration in the diet was increased from 0.53% to 0.87%. In the present study, an elevation of the urinary K:creatinine ratio was significantly apparent (P<0.05) when animal was given high Na in diet. It may be related to an increase in DMI resulting increase in roughage intake with usually containing high K in the forage (NRC, 2001). However the urinary Cl:creatinine ratio was unaffected by an increase in dietary Na_2CO_3. This was probably due to the existence of acid-base balance in the tubular lumen of kidney for the system of Cl^-/HCO^- exchange (Cunningham, 2002).

An increase in Na excretion in fecae was found when Na level in the diet was increased. Morris (1980) suggested that Na fecal excretion increased when Na uptake was increased. Fecal K in this study decreased when Na uptake of animal increased. This result was similar to the study of Clive et al. (2000). Potassium absorption is much higher with an increasing of Na level in the diet.

Nutrients digestibility

Apparent digestibility of DM, ADF, NDF, K, and Cl were unaffected by increasing Na dietary but digestibility of Na was increased (P<0.05). These results were similar to the report of West et al. (1987) that DM, ADF, and NDF digestibility tended to increase when increased Na dietary. Ben-Ghedalia et al. (1996) found that Na and K digestibility tended to increase when increased Na dietary. Canale and Stokes (1988) observed that DM, ADF, and NDF digestibility were significantly different when increased in dietary Na. Similarly, Roger et al. (1982) observed that DM and ADF digestibility tended to increase when increased Na (in form of NaCl or $NaHCO_3$) supplement in the diet.

An increase in Na level in the diet would increase both Na and K digestibility while no effect on Cl digestibility was found. In the present study, the mechanism of Na absorption was not performed. Apparent absorption of sodium in dairy cows fed with fresh herbage has been reported from 77% to 95% (Kemp, 1964), whereas apparent absorption of Na ranging from 53% to 81% were apparent in the present study.