



# NUTRIFAX

Nutrition News and Information Update



## A New Look at Sodium for Dairy Cows

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The sodium content of most plants and grains is very low in relation to the requirements of animals. Cattle have developed very efficient absorption mechanisms from the intestine and are able to conserve sodium by limiting loss through the kidneys and into the urine. The body has very small amounts of stored sodium that is readily available for use in metabolism. Feeding sodium in excess of the requirement leads to an increase in excretion with the usual environmental concerns, soil salinity and toxicity to plants.

There have only been small increases in dietary sodium requirements for dairy cows in recent years. The Dairy NRC (1989) lists the sodium requirement at 0.18% and the new Dairy NRC (2001) at 0.22% for high producing cows. The question is really whether this adequately addresses maintenance and increased production requirements of high producing dairy cows. Approximately half the daily sodium requirement is excreted in the milk.

Shur Gain research has re-evaluated sodium, potassium and chloride requirements for lactating dairy cows. The requirements were determined for the tissue fluid pools and the lactation requirements based on the ionic composition of milk. These requirements are calculated based on the cow weight, daily milk production and the daily dry matter intake. For example (Table 1), a 1400 lb (635 kg) cow producing 80 lbs (36 l) of milk on 48.5 lbs (22 kg) of dry matter would have the following requirements.

Table 1. The dietary sodium, potassium and chloride requirements for lactating dairy cows.

<u>Nutrient</u>	<u>Maintenance Requirements</u> (g/h/d)	<u>Lactation requirements</u> (g/h/d)	<u>Total requirements</u> (g/h/d)	<u>Requirements as % of total dry matter</u>
Sodium	32.8	33.7	66.5	0.30
Potassium	93.5	83.8	177.3	0.80
Chloride	43.5	56.5	100.0	0.45

The sodium requirement for production levels from 60 to 100 lbs, with appropriate dry matter intake adjustment, ranges from 0.28 to 0.32% of total dry matter.

The sodium requirement calculated (0.3% Na) is substantially higher than the new NRC 2001 and that currently used in the Pert model. There are a number of different ways that the sodium requirements can be met. These were evaluated in a recent trial (Table 2) with lactating dairy cows. The following treatments were used to evaluate the higher levels of the three dietary ions. A safety margin was included in each of the dietary ion levels.

Table 2. Evaluation of sodium sources to meet the higher requirements calculated for lactating dairy cows.

<b><u>Nutrient</u></b>	<b><u>Salt Sodium bicarbonate</u></b>	<b><u>Salt</u></b>	<b><u>Salt Sodium bicarbonate Potassium Chloride</u></b>
Sodium	0.42	0.42	0.42
Potassium	1.08	1.08	1.25
Chloride	0.63	0.92	0.62

The main trial results, though not statistically significant, are nevertheless interesting. There are some numerical differences worth noting (Table 3).

Table 3. Dry matter intake, milk yield, fat and protein percent of cows fed different sources of sodium.

<b><u>Nutrient</u></b>	<b><u>Salt Sodium bicarbonate</u></b>	<b><u>Salt (control)</u></b>	<b><u>Salt Sodium bicarbonate Potassium Chloride</u></b>
Dry Matter Intake (Kg / day)	20.9	19.2	20.8
Milk (l / cow / day)	45.0	40.1	44.6
Milk Fat (%)	3.74	3.69	3.53
Milk Protein (%)	2.87	2.99	2.96

Cows on the salt / sodium bicarbonate consumed 1.7 kg more dry matter per day and produced 4.9 more litres of milk compared to the control cows. The cows on the salt / bicarbonate / potassium chloride treatment performed nearly as well compared to the control, but the potassium level was higher than the calculated requirement. The salt / sodium bicarbonate treatment most closely met the requirements as calculated by the model. These results including the model calculations led to the recommendation that the sodium specification be increased from 0.2% to 0.30% of dry matter for lactating dairy cows using salt and sodium bicarbonate.

Table 4. The calculated requirements for the three ions compared to the levels used in the trial.

<b>Nutrient</b>	<b>Calculated Requirement</b>	<b>Safety adjusted requirement</b>	<b>Salt Bicarbonate</b>	<b>Salt</b>	<b>Salt Bicarbonate K chloride</b>
Sodium	0.30	0.42	0.42	0.42	0.42
Potassium	0.80	1.12	1.08	1.08	1.25
Chloride	0.45	0.63	0.63	0.92	0.62

The simplest way for us to implement this recommendation in Workbench is to include the amount of salt and sodium bicarbonate required at different dry matter intakes. Table 5 gives the requirements of salt and sodium bicarbonate based on 0.3% sodium in the total dry matter.

Table 5. Salt and sodium bicarbonate requirements (g/h/d) at different dry matter intake levels of lactating dairy cows.

<b>DMI Kg/h/d</b>	<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>
Salt (g/h/d) [0.2%Na]	90.0	95.0	100.0	105.0	110.0	115.0	120.0	125.0
Bicarbonate (g/h/d) [0.1%Na]	65.0	70.0	72.5	75.0	80.0	85.0	87.5	90.0

A simple rule of thumb can be used in most Holstein herds on a TMR. Feed 110 g/h/d of salt and 80 g/h/d of sodium bicarbonate. The Ontario database has no sodium value for both sodium bicarbonate and sodium bentonite. Setting minimum and maximum specifications for sodium, potassium and chloride to accommodate these specific amounts are most likely to trigger infeasible solutions in some feeding situations. The amount of sodium from forages and grains will not significantly increase the sodium specification much above 0.3% provided the appropriate dry matter, salt and bicarbonate numbers were used.

However, for those diets that include bakery byproduct, the amount of salt will need to be adjusted. For every 500 g (1/2 kg) of bakery byproduct fed, reduce the amount of salt fed by 10 g/h/d. Therefore, cows fed 1.5 kg of bakery must have the salt fed reduced by 30 g/h/d. In the rule of thumb given above, it would mean  $110 \text{ g} - 30 \text{ g} = 80 \text{ g}$  or 0.08 kg/h/d of salt.

In Ontario it is recommended that you follow these steps to ensure that the correct amounts of both salt and sodium bicarbonate are included in the feed formula to meet the 0.3% sodium requirement.

1. Leave the nutrient specifications for sodium, potassium and chloride as they appear in the model. (At present the Pert model does not automatically calculate these new requirements).
2. Under mill ingredients, enter a minimum amount for salt – 0.110 kg/h/d.
3. If required, adjust the salt level down to accommodate for the amount of bakery byproduct being fed. Example: for 1 kg bakery, reduce the salt by 20 g/h/d or  $110 - 20 = 90 \text{ g/h/d}$  of salt (or 0.09 kg/h/d).
4. Enter a minimum feeding level for sodium bicarbonate – 0.08 kg/h/d.
5. Formulate as usual.