THE EFFECTS OF SUGARS IN DAIRY COWS RATION

ED&F MAN
EST. 1783

SUGAR PLUS

Disclaimer: All information/data contained herein is based on the research references, as listed. Because specific farm circumstances and on-farm management practices vary, it is advisable to consult with your Technical Feed Advisor or Nutritionist in determining your optimum feeding regime.

WHAT ARE THE EFFECTS OF SUGARS FEEDING?

In Ireland, the average content of simple sugars in rations fed to lactating cows is well below the minimum requirement.

Recently published scientific research demonstrates the importance and effectiveness of simple sugars in dairy cows nutrition.

Here is an outline of the main effects induced by sugars added to dairy ration.

1 SUGARS MODULATE RUMEN FERMENTATIONS

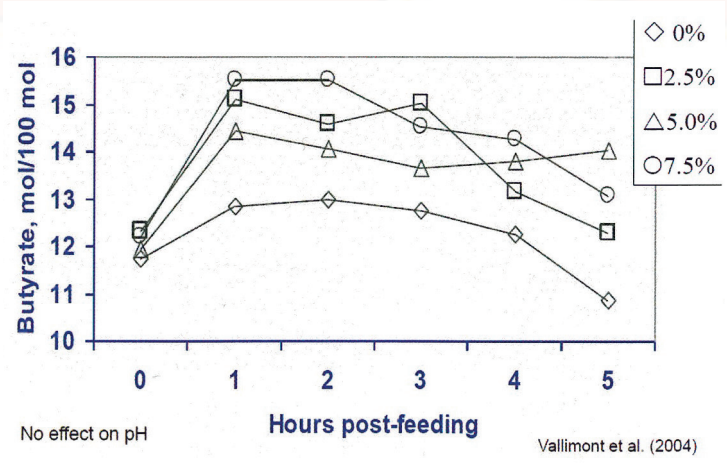
Simple sugars are soluble in rumen liquor. They constitute a source of energy immediately available to trigger the microflora fermentation.

Several studies have shown that the inclusion of simple sugars in rations fed to ruminants is able to modulate the growth of various components of the ruminal microflora.

Actually, sugars promote the development and maintenance of bacterial species such as Megasphaera elsdenii, which use the lactate as an energy substrate to produce VFA which are absorbed from the rumen epithelium, counteracting the pH decrease (Firkins, 2010).

It was reported that the inclusion of simple sugars added in the ration promote the production of butyrate, while having no effect on the production of propionate in lactating dairy cows (Hoover et al. 2006, Vallimont et al. 2004).

Butyrate is the main energy source of the cells of the rumen epithelium. Thus, enhanced development of rumen papillae could increase the VFA absorption by the rumen.



GRAPH #1

Effect of gradual replacement of starch with sucrose on butyrate production in vitro (Vallimont et al, 2004)

2 SUGARS TEND TO INCREASE RUMEN pH

Diets in which part of the starch is replaced by simple sugars (sucrose and lactose), do not induce a decrease in rumen pH in lactating cows.

Penner and Oba (2009) reported that feeding a diet supplemented with 4.7% of sucrose increased the rumen pH and reduced the duration that ruminal was below 5.8 in dairy cows during the postpartum phase.

A higher and stable rumen pH during the day is an essential condition to promote the development and activity of cellulolytic bacteria and to counteract the occurrence of sub-acute ruminal acidosis (SARA).

	Sugars, % DM	
	2,8	5,8
Ruminal pH		
Min	**5,44**	**5,66**
Average	**6,17**	**6,34**
Max	**6,81**	**6,96**
Ruminal pH < 5.8, min/d	**298**	**107**

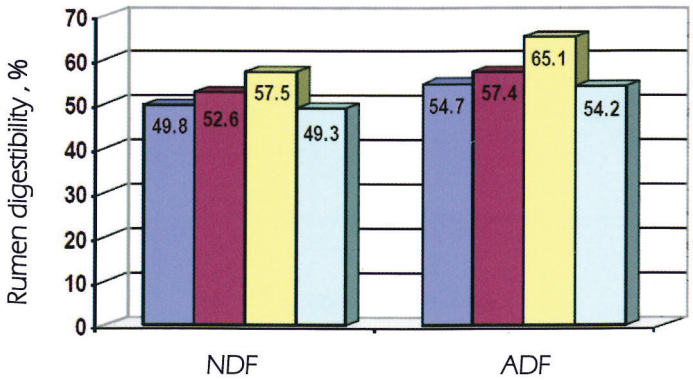
TABLE #1

Effect of two simple sugars levels in ration fed to dairy cows on rumen pH. Adapted from Penner & Oba, 2009.

3 SUGARS IMPROVE FIBRE DIGESTIBILITY

Sugars influence the transient fluid-phase bacterial populations. It was suggested that cellulolytic bacteria, adhering to the fibre particles, may benefit from the metabolites, such as peptides and amino acids, produced by bacteria which ferment sugars.

Broderick and Radloff (2004) found that the substitution of increasing amounts of starch with sucrose improved rumen digestibility of NDF and ADF fractions of the fibre, with a maximum effect observed when sugars amounted to 5% of ration dry matter.



GRAPH #2

Effect of increasing amount of sucrose in ration on fibre digestibility in rumen. Adapted from Broderick et al, 2008.

4 SUGARS IMPROVE MICROBIAL PROTEIN PRODUCTION

Microbial protein has a high biological value, as it provides 50 to 80% of the amino acids that can be assimilated by the cow in the intestine. Therefore, the optimisation of microbial protein production is important to improve the efficiency of the use of nitrogen.

The rate of digestion (Kd) of simple sugars is higher than 40%/hr, while the rate of degradation of the starch ranges from 8 to 30%/hr.

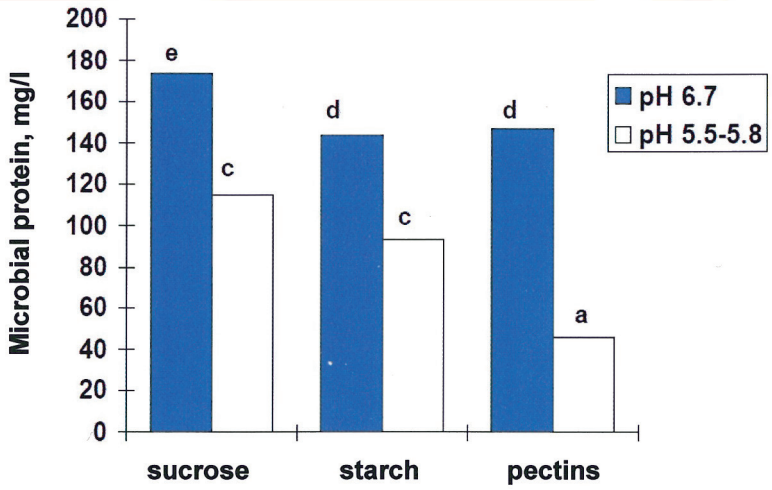
The synchrony in the ruminal availability of rapidly fermentable sugars and protein or NPN promotes a more efficient development of the microflora and a higher production of microbial protein.

An in vitro study conducted on a mixture of rumen bacteria showed that sugars stimulated a higher production of microbial protein per unit of fermented organic matter (Graph #3).

Feeding rations containing barley and 5.6% sugar (D.M.), increased the microbial protein production in heifers by 25% (Piwonka et al. 1993).

Furthermore, it was observed that sugars support the development of bacteria with proteolytic activity, such as Prevotella spp, that release peptides and amino acid available for fibrolytic and amylolytic bacteria metabolism, without producing ammonia (Walker et al. 2005).

A more efficient N metabolism is a key factor to contain urea in blood and milk.



GRAPH #3

Production of microbial protein in the presence of different carbohydrates and pH in vitro. The different letters indicate P < 0.05. Adapted from Stroebel & Russel, 1986.

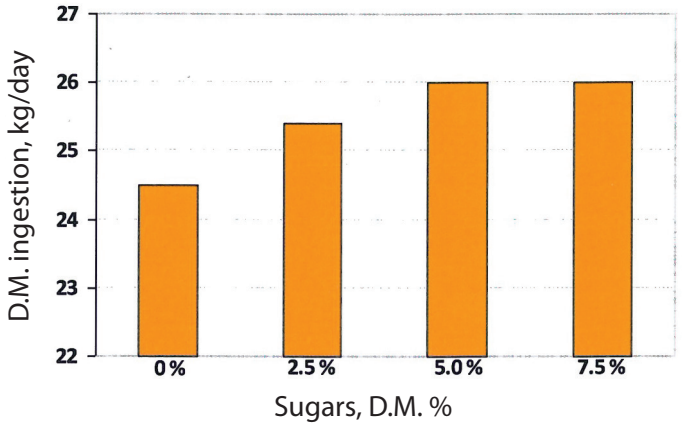
5 SUGARS IMPROVE DRY MATTER INTAKE

The increased palatability of the ration supplemented with sugars improve the voluntary dry matter intake. Oldick et al (1997) reported that the inclusion of molasses in the ration (3.4% of D.M.) improved the feed conversion efficiency and increased milk production of 1.3 kg per day.

The graph shows the effect of different amounts of simple sugars in a silage based ration fed to lactating cows: the substitution of 5% of corn starch with an equal amount of sucrose induced a 7% improvement of dry matter intake (Broderick et al. 2008).

GRAPH #4

Effect of substitution of starch with simple sugars on intake of lactating cows. Adapted from Broderick et al. 2008.



6 SUGARS IMPROVE MILK PRODUCTION & QUALITY

Sugars are a strategic source of energy for ruminal microflora: they are quickly metabolised by bacteria and allow a rapid growth of the population that can ferment more efficiently other feed components, particularly the fibre. Broderick et al (2000, 2008) have shown that a correct balance of simple sugars and starch in the ration is important to improve the production performance and milk quality.

As reported in Table #2, the replacement of increasing amounts of corn starch with sucrose in a silage-based ration increased fat corrected milk production (FCM) and also milk fat and protein production.

TABLE #2

Effect of substitution of increasing amounts of starch from high-moisture corn with sucrose on milk production and quality (Broderick et al 2008).

	7.5% Starch	5.0% Starch	2.5% Starch	0% Starch
	0% Sucrose	2.5% Sucrose	5% Sucrose	7.5% Sucrose
Milk, kg/day	38.8	40.6	39.4	39.3
FCM, kg/day	40.7	42.1	43.8	39.5
Fat, %	3.81	3.80	4.08	4.16
Protein,%	3.24	3.22	3.27	3.3

SUMMARY

THE BENEFITS OF SUGARS IN DAIRY COW RATIONS

FEATURE	BENEFIT
Increased production of butyrate which improves VFA absorption [1]	Higher efficiency of the rumen epithelium
Rumen pH at higher optimal levels and reduced pH fluctuations [2]	Helps prevent onset of acidosis & increases DMI
Increased fibre digestibility [3]	Greater use of forages in total diet
Optimises microbial protein production in the rumen [4]	Accommodates a lower amount of protein sources in the ration
Increased palatability of the ration [5]	Good energy intake, avoiding the effects of negative energy balance
Increasing the proportion of molasses (sugars) in the dairy cows diet [6]	Increases milk production & milk composition
It is a liquid feed containing approx. 70% DM	A lower substitution effect compared to dry feeds, thereby boosting DMI and in turn, output

PUBLISHED RESEARCH REFERENCES

[1] **Vallimont et al 2004**
Effect of gradual replacement of starch with sucrose on butyrate production in vitro

[2] **Penner and Oba 2009**
Effect of two simple sugars in ration fed to dairy cows on rumen pH.

[3] **Broderick et al 2008**
Effect of increasing amount of sucrose in ration on fibre digestibility in rumen

[4] **Stroebel and Russel 1986**
Production of microbial protein in the presence of different carbohydrates and pH in vitro

[5] **Broderick et al 2008**
Effect of substitution of starch with simple sugars on intake of lactating cows

[6] **Murphy JJ 1996 – Moorepark**
The effects of increasing the proportion of molasses in the cows diet on milk production and composition

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Contact – **ED&F MAN Liquid Products Ireland Ltd**
Tel**: 045 481070** • Email: **dublin@edfman.com**

www.sugarplus.ie

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