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Rational development of new additives

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Do ruminants care about palatants?

AROMAS, FLAVOURS AND SWEETENERS ARE COMMONLY USED TO IMPROVE PALATABILITY. IN RUMINANT NUTRITION HOWEVER, THEIR EFFICACY REMAINS GENERALLY UNCLEAR. IT IS TIME TO FOCUS THE USE OF PALATANTS INTO SPECIFIC APPLICATIONS, SAYS PATRICK SCHLEGEL.

Patrick Schlegel graduated in animal sciences from the Swiss Federal Institute of Technology in Zurich (ETHZ) in 1999. After having worked as a teacher in an agricultural school, he decided to enter into the challenging industry of feed additives and joined Pancosma S.A. in Geneva. Within the company, he is responsible for all nutritional aspects and the studies concerning palatants, as well as Pancosma's organic trace minerals.

Every year, some 150 million Euros are spent on the use of palatants for livestock feed. About 15-20% of these are included in pre-ruminant and ruminant mineral feeds, milk replacers, liquid supplements, compound feeds or total mixed rations (TMR). With palatants, we generally speak either about aromas, flavours, sweeteners or their combinations which are included into feeds at low doses, ranging from 100 g/t to 1000 g/t depending on the product intensity. These additives are designed to provoke a sensory response that, in the end, affects feed intake and performance. There are several reasons for using this type of non-nutritive feed additive, but they can ultimately be grouped into two major ones: marketing and/or performance.

PALATANTS AS MARKETING TOOLS

The wide variety of existing flavour types, from vanilla through fruity to herbaceous, even including more uncommon flavours such as chocolate, mango or hay, help create an unlimited range of brand-specific feeds. Palatants give an identity to the feed and guarantee flavour continuity in aroma and taste, since they are ingredients which limit the variations originating from batch to batch feed production irregularities, especially if by-products are used.

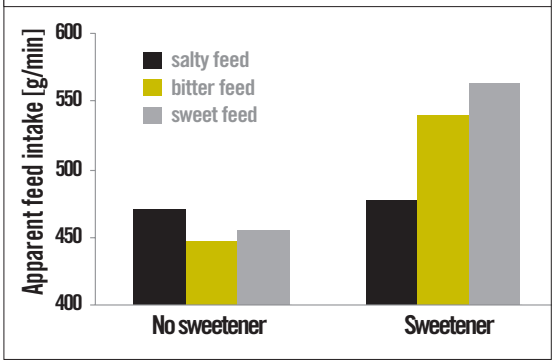
Finally, palatants have been used successfully in human nutrition and as humans we reflect this affection in the sweetness and the flavour on the feeds we produce for animals.

But in the end, do ruminants care about palatants?

ATTRACTIVE TO DAIRY CATTLE

The ruminant's feed intake is influenced by environmental stressors (climate, transports, herd management etc.), by the animal itself (e.g. age, body weight, lactation, experience of diet) and finally by the physical and chemical characteristics of the diet. Particle size, pellet hardness or roughage content in a TMR for example, are physical characteristics that contribute to the sensory response invoked by the animal (Baumont, 1996; Galean and Defoor, 2003). Taste and odour are also recognised as important chemical characteristics in feed attraction. Chiy and Phillips (1999) studied this in compound feed for dairy cows as being sweet, salty or bitter, with or without including an additional sweetener (*Figure 1*).

FIGURE 1 - APPARENT INTAKE OF SALTY, BITTER AND SWEET FEED WITH OR WITHOUT A SWEETENER



The authors concluded that bitter and to some extent salty compound feeds were consumed at a slower rate than sweet ones. The addition of a sweetener improved the apparent rate of feed intake, especially for salty and sweet feeds. Nombekela *et al.* (1994) came to a similar conclusion: dry matter intake (DMI) in dairy cows was increased with a sweetened TMR compared to a control, but decreased when the TMR was salty, sour or bitter.

A recent study conducted by Jennifer Bell at the Scottish Agricultural College in the UK evaluated, in a change-over design, the potential use of citrus pulp by-product and its replacement by a liquid fenugreek type flavour (Covatone® - Spray, Pancosma, Switzerland) in a compound feed. The reactions of mid-lactating Holstein-Friesian cows demonstrated the effects of citrus pulp or fenugreek flavour if added or removed from the control feed (*Table 1*). The attractivity of the flavour was equal to citrus pulp, which leads to the conclusion that the fenugreek flavour can easily replace a palatable citrus by-product if needed.

With the help of the above given examples, it is generally well accepted that palatants enhance the feed's attractivity in ruminants. But do we get more performance out of this? Is milk production or weight gain increased? Is less feed wasted? Are management costs reduced? Are medication costs reduced? Finally, is the return on investment positive? These are the ultimate questions, but until today answers are difficult to find, since the literature is scarce on the subject of palatability in modern ruminant nutrition. Research into palatants for ruminants has recently been focused on their benefits in production systems where feed intake is a seriously limiting productivity factor, for example in weaning calves, intensive beef feedlot production, in animals under heat stress or in robotic milking systems, where compound feed could be considered an "attractant" to the robot.

PALATANTS IN ROBOTIC MILKING SYSTEMS

The Animal Production Research Institute Cremona in Italy (Migliorati *et al.* 2003) has conducted some research into the use of palatants as attractants in robotic milking systems. Robotic milking systems rely especially on "non-forced cow traffic systems", feed offered in the milking box to motivate cows to get milked. Next to optimisation of herd management, compound feed palatability may play a role in reducing the number of "lazy" cows and to guarantee an adequate number of daily visits to the robot. Forty Italian Friesian cows were divided into two groups, within the same barn and with access to the same milking box. Two compound feeds (50% wheat bran, 50% corn) differing only in their palatability using a high intensity sweetener (Sucram®), combined with a fenugreek flavour were delivered to the milking box for two weeks; one for each group following a one-week adaptation period in which both groups received the control feed alone. The most interesting "attractivity" records were the number of visits to the gate of the milking robot waiting area, since this was of unlimited access compared to the limited access for effective milking (minimum 5 hour interval). The number of visits increased by 14% with the sweetened and flavoured feed (*Table 2*). Previous to this study, the high intensity sweetener alone and the fenugreek type flavour alone had been tested without clear success on the same parameters. It can therefore be concluded that, depending on the specific situation, only a combination of aroma and taste are effective enough to get the cows attracted to the feed.

TABLE 1 - EFFECT OF DIET CHANGE ON RATE OF FEED INTAKE IN DAIRY COWS

Changes	Control	Citrus to...	Flavour* to...
...to Control	-	-3.9%[c]	-2.3%[cd...]
...to Citrus	+2.0%[ad]	-	+1.6%[ac]
...to Flavour*	+5.5%[ab]	+0,7%[ac]	-

[a, b, c, d] Means with different superscripts differ significantly (P<0.05).

* Covatone® spray, Pancosma, Switzerland

TABLE 2 - EFFECT OF PALATANTS ON VISITS TO THE MILKING ROBOT

	Control	+ Palatants*
Visits to the milking robot gate/cow/day	3.88[b]	4.43[a]
Number of milkings/cow/day	2.44	2.52
Milk production (kg/cow/day)	24.0	24.0

[a, b] Means with different superscripts differ significantly (P<0.05).

*Sucram® and Covotek®, Pancosma, Switzerland.

A GOOD START FOR WEANING CALVES

Feed attractivity is also one of key success factors in good and healthy growth with rapid rumen development in weaning calves. To reach this goal, solid feed intake (roughage, compound feed) has to be maximised in the

Palatants may help maintain feed intake during periods of stress, such as transport or transfer to the beef feedlot..

early stages. Research conducted at the University of Leeds in the UK compared the intake and growth rate of calves offered a compound feed with or without the inclusion of a high intensity sweetener.

At the beginning of the trial (at two weeks of age), the daily compound feed intake was equal between treatments. From the 2nd week, differences appeared: with the use of the sweetener, compound feed intake increased more quickly ($p<0.05$) and more regularly than without its use (*Figure 2*). After six weeks, with an age of eight weeks, calves that received sweetened compound feed consumed almost twice as much (+81.6%) and weighed 9 kg more (+13.3%) than the ones receiving the unsweetened feed ($p<0.05$).

These findings suggest that young animals coming into contact with solid feed for the first time are more likely to accept sweetened feed. Several other production systems are confronted with the same problem- the acceptance of unknown feed. A classic example is in beef production where, under feedlot systems, beef calves are separated from pasture and cow's milk and within a few days discover the feedlot pens and their first TMR, containing only 40% roughage and 60% of unknown concentrate.

PERFORMANCE IN FEEDLOT BEEF CATTLE

The initial few weeks after arrival of a recently weaned beef calf into the feedlot is a highly critical period. These animals are simultaneously adapting to a new environment (climatic conditions, housing system, feed etc.) and overcoming the stresses of weaning, transportation and grouping. Stress leads to low feed intake, which is a significant impediment to improving health and performance.

Two 56-day receiving feedlot studies were conducted at West Texas A&M University, (Brown, 2003) and Texas Tech University (Rivera *et al.* 2004) in the US.

In the first study, 176 steers were given a TMR including 0, 100, 200 or 300 g/t DM of a high intensity sweetener. Feed intake was improved by 17% and body weight gain by 23% with 200 g/t DM of the high intensity sweetener!

The second study consisted of 200 steers and was set up for confirmation with two treatments: either no sweetener or its inclusion at 200 g/t DM. The intensive sweetener again improved performance (+4% DMI, +7% BWG), but to a lesser extent than in the Texas A&M study, since general performance was better, which limits the potential for improvement.

The pooled performance data of both studies including a total of 288 steers (*Figure 3*), resulted in improved feed intake ($p=0.17$). The increased feed intake was beneficial to the steers in improving their health status and therefore limited the need for medical treatment (-5% pulls; -21% repulls). Finally, body weight gain ($p=0.18$) and feed efficiency were improved. The calculated return on investment of the sweetener was 1:19 in the West Texas A&M study and 1:10 in that conducted at Texas Tech.

FIGURE 2 - COMPOUND FEED INTAKE RELATIVE TO BODY WEIGHTS OF WEANING CALVES

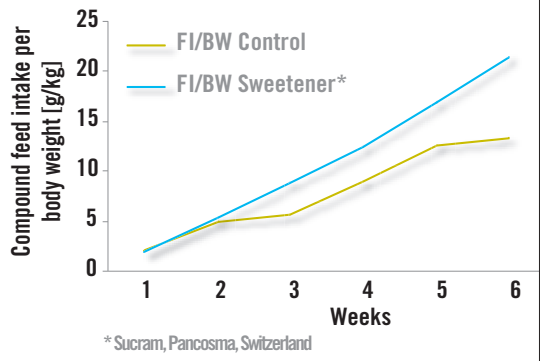
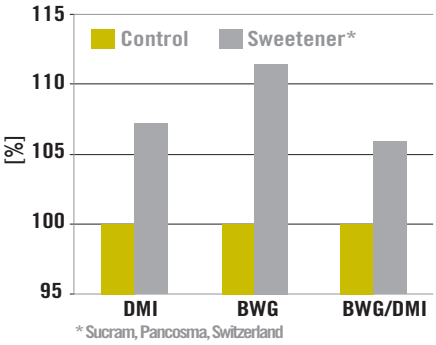


FIGURE 3 - RELATIVE EFFECTS OF A SWEETENER* IN RECEIVING FEEDLOT BEEF



CONCLUSIONS

Palatants have always been important additives in ruminant nutrition, but mainly for marketing purposes. Recent research has shown that calves, dairy cows or even beef cattle are react effectively to flavours and/or sweeteners in specific production systems, ultimately offering the producer a positive return on investment. Yes, ruminants do care about palatants! <-

References are available from the author on request.