Improving productivity in weaned piglets with the use of sweeteners

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Among the five basic tastes (sweet, salty, umami, bitter and sour), bitter sensitivity is the most pronounced. It is perceived by taste buds located on the back of the tongue and is the most durable taste. Bitter substances are generally rejected as soon as they are detected because they are usually associated with products that are generally harmful to animals (most poisons are bitter).

Bitter tastes are exclusive complex organic substances, especially alkaloids (many fatal plant toxins are alkaloids). Trivalent nitrogen and amine groups appear to be common components of bitter substances, as well as inorganic salts of high molecular weight.

Most medications and antibiotics are very bitter, which is why their use in piglets' feed can produce rejections or at best lower consumption. To avoid this reaction and the consequences over production parameters, the use of zero-energy intensive sweeteners is a common practice to counteract any unpleasant taste, especially bitter ones.

Feed intake

The feeding behaviour of animals is a process that depends on a sum of aspects from the moment the feed is sensed, through the action of eating and until feeding ceases. This can be interrupted and altered by other factors (see Table 2).

The objective of the use of flavouring substances is to improve the palatability and appetence of the feed, which can be defined as:

- **Palatability**

The quality of a feed as perceived by the oral senses; these characteristics are physical (depending on the technology of feed preparation) and chemical (gustation and retro-nasal stimulation).

- **Appetence**

The attraction caused by the sensory perception before eating the feed (smell) and during intake (taste). Appetence exerts a positive effect on food intake until the satiation threshold is reached.

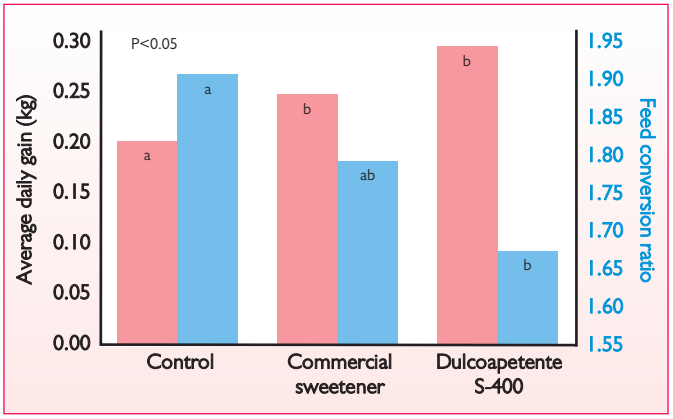

Fig. 1. Average daily gain and feed conversion ratio (49 days).

Sweeteners

We can define sweeteners as the substances capable of adding sweet flavour to other compounds.

Sweeteners are often classified according to:

- Their source: natural, semi-synthetic, synthetic.
- Whether they are nutritional or non-nutritional (available energy): most nutritive sweeteners are derived from plants, an exception is stevioside, which is non-caloric.

Each sweetener has its own characteristics that differ from others – such as the sweetness profile, stability at high temperature, pH, solubility, and sweetness intensity.

This last characteristic refers to the potency as a sweetener and is calculated by the threshold of perception in relation to sucrose, which is given per unit value (for exmaple 1g of sodium saccharin is approximately equivalent to 300-500g of sugar)

Intense sweeteners are those that only provide sweetness and have no nutritional value; their 'sweetening power' is very high, most are synthetic and typically used in dietary products as well as medications.

Commercially, it is common to find combinations of two or more sweeteners to produce a synergism that will give a power of action that would not be achieved individually and which also counteracts any aftertastes (the metallic taste of saccharin).

Pigs show a strong preference for sweet substances and in particular for sugar as is witnessed by the rapid consumption of sweetened food.

It is important to remember that the legislation in the European

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Table 1. Sources of some bitter tastes.

Vegetable		
Found in:	**Family**	**Source of:**
Sorghum, grape seed, sunflower meal	Tanins	
Citrus pulp	Flavonoids	Naringin, neohesperidin
Alfalfa, soya	Glucosides	Saponins
Bitter almonds	Glucosides	Amygdalin
Linseed	Glucosides	Linamarin
Cotton seed	Glucosides	Gossypin
Medications		
Erythromycin, amoxicillin, colistin, chlortetracycline etc.		

Table 2. Factors influencing feed intake.

In relation to:	Factors
The animal	Species, age, weight Digestive tolerance – often associated with feed Health status of the animal The threshold of satiety (reached by feed volume or metabolic satiety thresholds)
The environment	Hygiene of site/trough Temperature Moisture present Ventilation
The feed	Digestibility Appetence Palatability

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Union only allows the following sweeteners for animal feeds:
- All-natural sweeteners.
- Saccharin (sodium, calcium) in piglets up to four months: maximum dose150ppm.
- Neohesperidin dihydrochalcone: 35ppm in piglets up to four months.

Experimental trial

A trial was carried out with two objectives:
- Compare parameters of animal production (weight gain, consumption, and conversion ratio) between a medicated feed with two different combinations of sweeteners against a control (unsweetened).
- Evaluate the effectiveness of the product Dulcoapetente S-400 (combination of intense sweeteners) against another commercial mixture of intense sweeteners found in the market.

Materials and methods

There were a total of 36 male piglets, weaned at 21 days, with an initial average weight of 6.3kg±0.03. The animals were grouped according to initial weight. All animals were individually tagged at the start of the trial.

The experimental diets were formulated according to FEDNA raw materials and composition tables and were provided in meal form.

All diets were iso-nutritive covering or exceeding the requirements of the NRC (1994) for animals of this age. For trial purposes we included in the feed the most commonly found antibiotics used in Spain for rearing stage:
- Amoxicillin: 300ppm.
- Colistin: 200ppm.
- Zinc oxide: 3.1kg/tonne.

The piglets were assigned to three experimental treatments:
- T1: Control (including antibiotic).
- T2: Control (including antibiotics) + 155g/Mt commercial sweetener (saccharin sodium content 150ppm).
- T3: Control (including antibiotics) + 200g/Mt Dulcoapetente S-400 (sodium saccharin content 150ppm).

The amount of saccharin sodium in diets T2 and T3 was identical and corresponded to the maximum amount permitted by European Union legislation.

Each treatment was replicated twice. The test duration was 28 days. The animals were housed in a clean and disinfected building. Each pen had ad libitum access to feed and water.

The controls were:
- Production parameters: Number of animals, live weight at 21, 35 and 49 days, feed consumption per pen for the periods 21-35, 35-49 and 21-49 days.
- Mortality.
- Incidence of diarrhoea.

All data was analysed using the SAS PROC GLM. The type of diet was included as 'treatment' in the model: Y = average + treatment + error.

Each treatment was replicated two times and each replication consisted of six piglets at the start of the trial.

Sweetener	Intensity
Sodium saccharin	300-500
Neohesperidin dihydrochalcone	1500-1800
Aspartame	180
Cyclamate	30
Thaumatin (natural)	2000-3000
Sucralose	600
Acesulfame potassium	130-200

Table 3. The sweetening power of different intense sweeteners.

Discussion

The obtained data (Table 3) shows that the animals treated with a sweetener in the feed (T2 and T3) achieved a higher body weight at the end of the trial compared to the control treatment.

The differences in weight gain were statistically significant and show that animals receiving diets with sweeteners grew between 26 and 36% higher than animals that received the control diet.

Moreover, animals fed Dulcoapetente S-400 (T3) increased ADG by 8% more than those given the feed with the other commercial sweetener (T2).

Diets T-2 and T-3 were more consumed than the control feed; the highest ADFI corresponded to the diet with Dulcoapetente with S-400 (+20% compared to control).

The positive tendency in consumption and weight gain of the sweeteners diets was also continued when calculating the feed conversion ratio; statistically Dulcoapetente S-400 treatment presented the better feed conversion ratio, a 6% better than the other commercial sweetener (T-2) and a 12% less than control (T-1).

The results of the trial at 49 days are summarised in Table 4.

Conclusions

The test results confirm the hypothesis that medication negatively affects feed intake. The addition of sweeteners to medicated piglet feeds contributes not only to less or no rejection of the feed but also increases the consumption ratio contributing to better growth of the animals and obtaining a better rate of conversion. This shows that sweeteners are a key tool for the nutritionist in masking bitter or unpleasant flavours.

We also see that the piglets fed the feed containing Dulcoapetente S-400 had both a higher consumption rate and better feed conversion (although not significant with respect to the other commercial product).

These results confirm that the flavour obtained from Dulcoapetente S-400 had a better response; this may be due to the synergy of its intensive sweet compounds and aftertaste inhibitors working in perfect balance. Finally we can conclude that when selecting a sweetener it is important to consider not only cost/dose or cost/tonne of feed but it is also crucial to consider its effect on the growth performance of pigs to result in more profitable growing and fattening stages. ■

References are available from the author on request

Table 4. Body weight, weight gain, feed intake and feed conversion ratio of piglets at 49 days old. Different letters means statistical differences. (p<0.05). *Coefficient of variation.

Parameters per piglet	T1	T2	T3	CV* (%)
Avg. initial weight (kg)	6.74	6.72	6.72	0.33
Avg. final weight (kg)	12.60[a]	14.13[b]	14.73[b]	2.74
Avg. daily weight gain (kg)	0.209[a]	0.265[b]	0.286[b]	5.52
Avg. daily feed intake (kg)	0.400[a]	0.474[b]	0.481[b]	2.74
Feed conversion ratio	1.91[a]	1.79[ab]	1.68[b]	3.09