NutriForum 24

# Animal feed behavior

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## We all come from animals!

## Palatability concept: Adapt the solution to the normal animal feed behaviour

- Human feed behaviors and link with animals
- Research: from the beginning
- Taste: discriminant for the feed risk
- The animal factor: ruminant specification
- Principle of the feed choices in ruminant
- Melbourne University trial: impact of palatability product on robot milking visits
- APIV: new tool to manage the Palatability formulation

# Studies about innate facial reflex




Without any knowledge about food, we react positively or negatively to different tastes.

All animals react the same. This sensitivity impacts the feed intake and the feed behavior.

Peiper 1963; Steiner 1973, 1977; Cowart 1981; Ganchrow et al. 1983; Rosenstein and Oster 1988, 1997; Steiner et al. 2001

# How the taste influence the feed behavior?



**Sweet taste** gets a **strong hedonic value** because it represents the fundamental energy of cells.
Sugar is life.

The smells linked to sugar will be looked for in priority by animals to cover the needs in energy.

# How taste influences feed behavior?



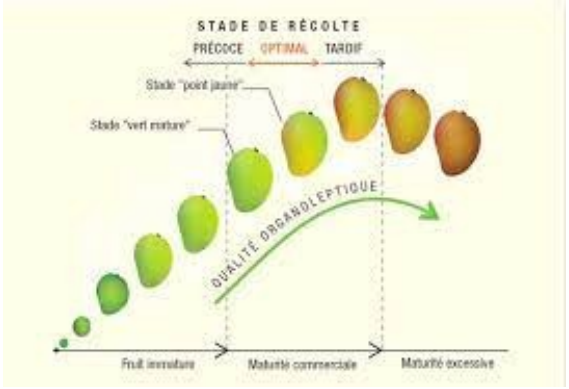
**Bitterness** indicates the presence of alkaloids protecting plants from predators (poison)
- Why don’t cows eat thistles in the fields?
- Why do cows eat hay thistle?
Desiccation destroys alkaloids.

# How taste influences feed behavior?



**Sour taste** allows to discriminate the ripening of fruit until alcoholic fermentation
Molds consume sugars and turn them into acids.

The appearance of metabolites and mycotoxins is possible.



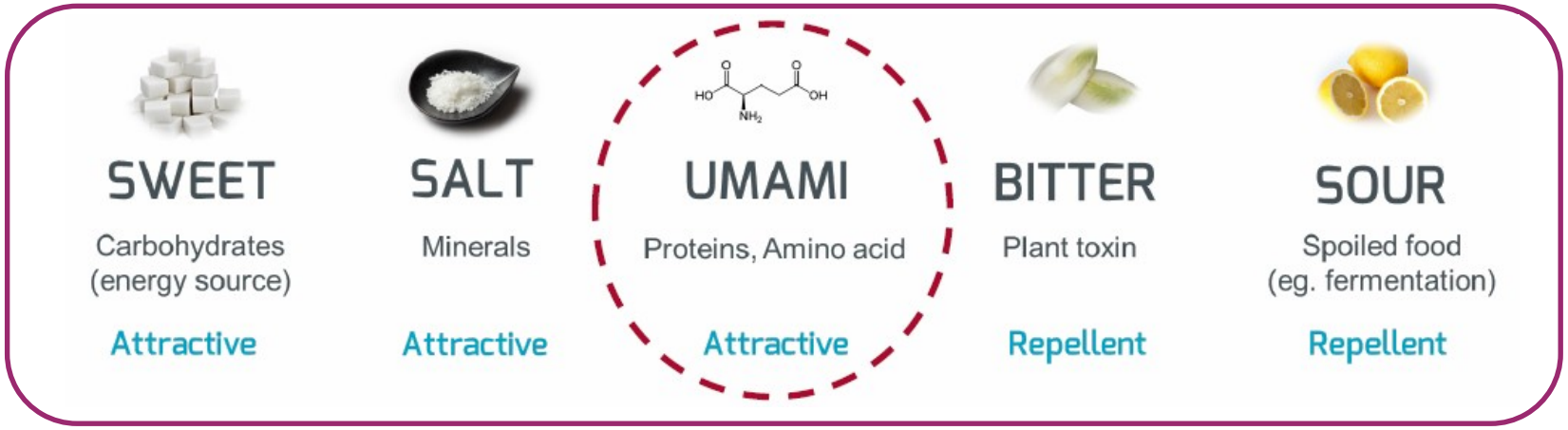

# How taste influences feed behavior?

**Salt** is necessary for life but naturally regulated by osmotic pressure.

As for minerals, the need is real but controlled.

# Umami






- Umami is described as the 5th taste, part of the appealing ones with sugar and salt
- The umami taste is induced by amino L glutamate (and more generally the family of glutamates and taste enhancers)

## Effects on animals

- Leads to a preference for the feed in which it is added *(Gherardi and Black 1991)*
- Increases ingestion *(Colucci and Grovum 1993)*
- **Decrease of the cortisone levels (stress hormone) in the blood one hour after meal** *(Favreau et al., 2010; Ginane et al., 2011a)*

# What is Palatability?

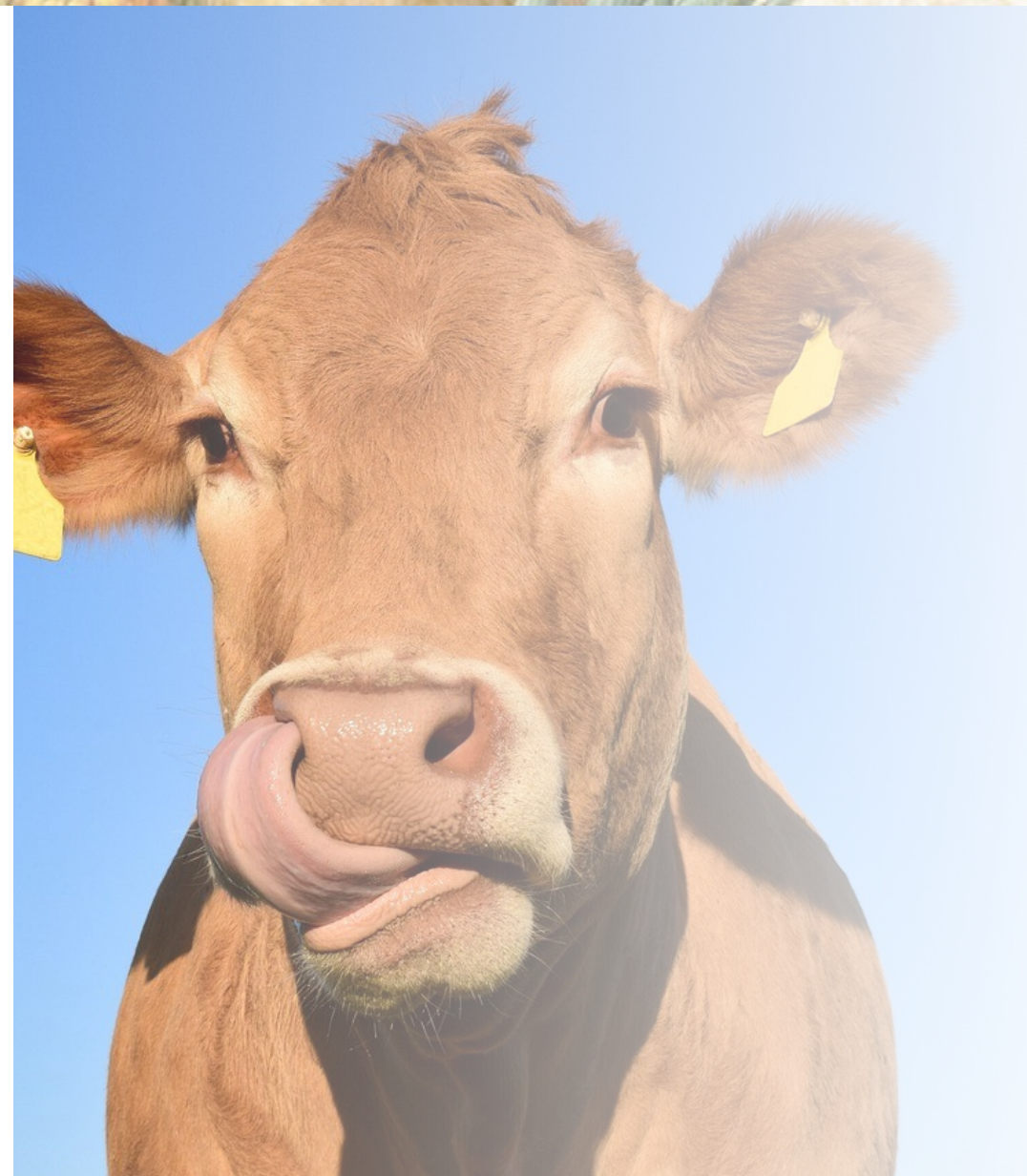
- Ruminants, like many other animals, have been shown to associate the sensory characteristics of food with their post-ingestive consequences *(Provenza 1995, Forbes and Provenza 2000).*

- Palatability is a reference to the ability of food to cause an immediate pleasant sensation.

- The concept of palatability is very closely linked to post-ingestive consequences *(Provenza 1995)* or even totally determined by them *(Garcia 1989).*

# Three parameters infuencing feed behavior and palatability

- **Olfactory perception –** retronasal olfaction
- **Taste** and number of receptors
- **Pre and post ingestive effect**



# Olfactory perception



Olfactory (visual, auditory)

Scents, perfumes,
food aroma
Pheromones
Predator smells

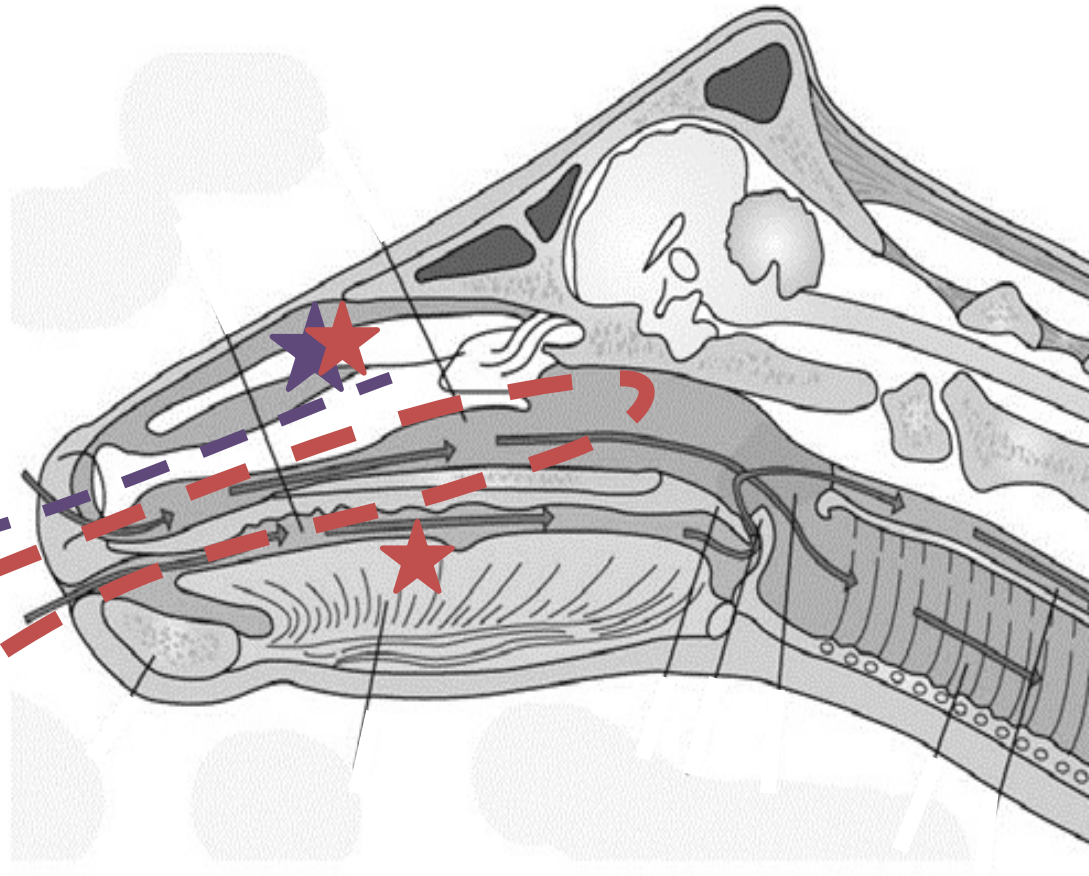
**Orthonasal**

Olfactory
Gustator
ySomatic

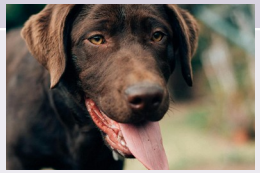
**Retronasal**

Food volatiles

**The flavor system**



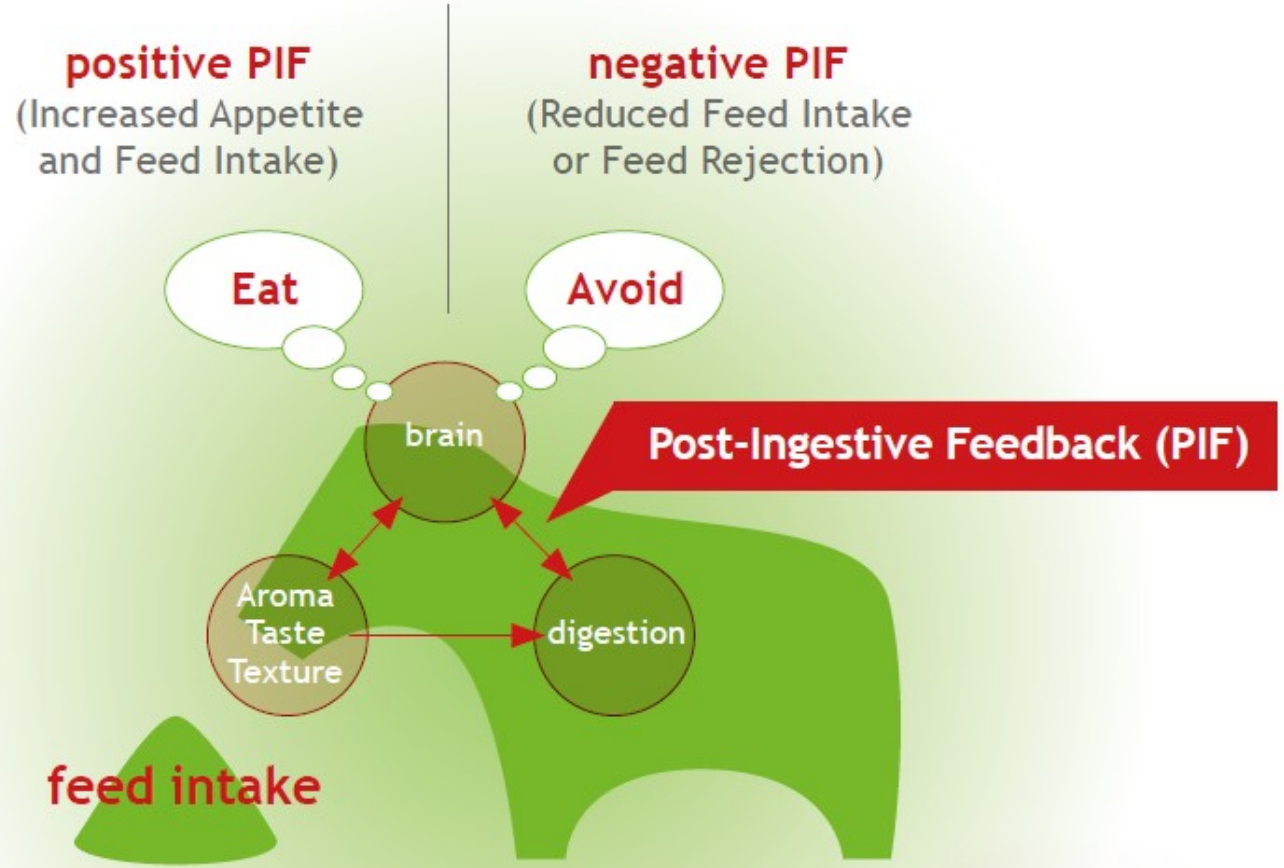
# Sensitivity to taste

| | Taste Buds |
|---|---|
| Cow  | 25000 |
| Pig  | 20000 |
| Humar  | 7000 |
| Dog  | 1700 |

Ruminants are much more sensitive to taste than humans and are particularly sensitive to bitter tastes

# Why is palatability important?

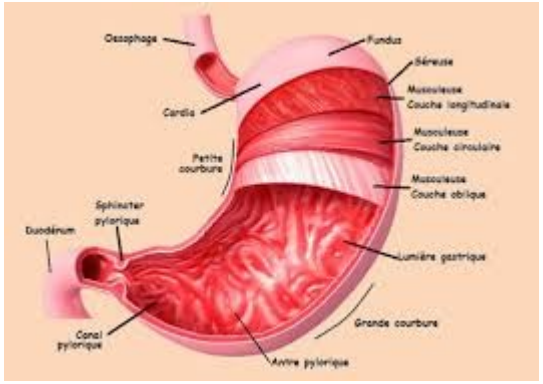


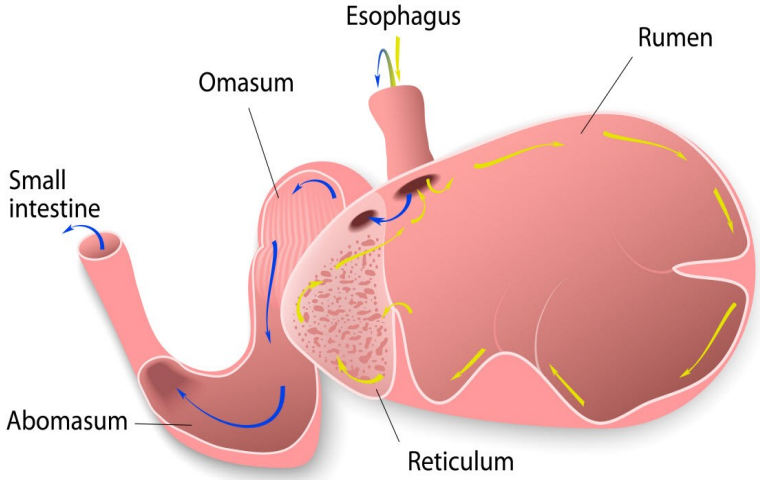



(Adpated from Provenza et al., 1992).

# Integration of the animal factor

- In evolution, individuals who are able to make the best food choices have dominated…
  Fundamental difference Between Human, Pig, Dog, Cat AND cattle, horses, rabbits, rats, guinea pigs…




**The rumen is a sac surrounded by muscles, stimulated by the fibrosity of the ration.**

**It conditions rumination.**

**Not all the muscles can contract at the same time to reject the food.**

Farm animals therefore develop discriminating tools.
Smell and taste are supposed to be indicators of food quality
and hedonic value.

*“Nutrition can only begin when feed is eaten.”*

# The effect of a dietary feed additive (Red fruit flavor) on automatic milking robot usage of early and late lactation cows grazing pasture

University of Melbourne
School of Agricultural Sciences
Dookie Campus Dairy Farm
2022

# Protocol




- 80 cows divided by lactation stage into two groups of 40 cows:
  - **Early lactation <3 months**
  - **Late lactation >4 months**
- Cows in each group randomly allocated to one of two dietary treatments fed in the milking robot
  - **Control – standard pelleted feed (16% CP)**
  - **Treatment – standard pelleted feed (16% CP) + Flavor 500g/t**
- Feeding regime:
  - **All cows grazed the same pastures supplemented with the same hay/silage as a partial mixed ration according to normal farm practice (~21kg DM)**
  - **Pelleted feed offered in robot at fixed level according to normal farm feeding regime (milk yield/lactation stage)**
- Individual cow data collected automatically by Lely Robots via RFID tags
- Trial Duration 8 weeks

# Results (n=80)

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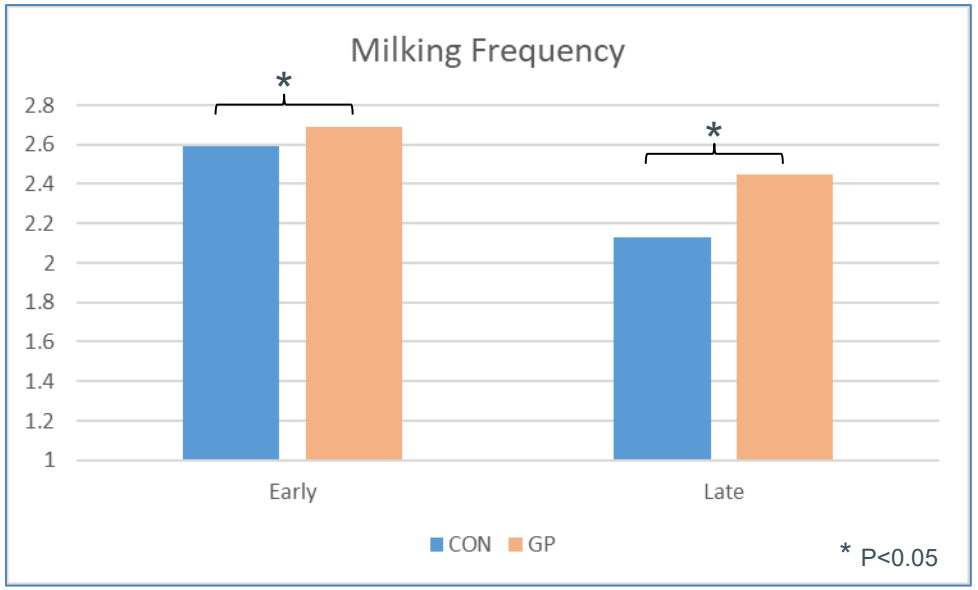
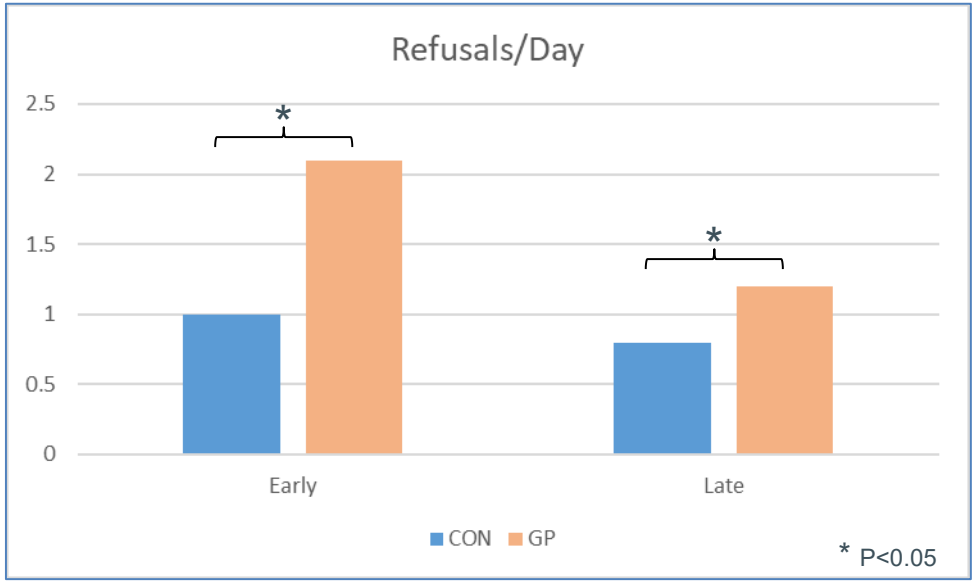
| | Early Lactating | | Late Lactating | | Significance (P Value) | | |
|---|---|---|---|---|---|---|---|
| **Parameter** | **CON** | **GP** | **CON** | **GP** | *Lactation Stage* | *TRT* | *Lactation * TRT* |
| Body Weight (kg) | 604.4 | 597.9 | 591.0 | 595.8 | *NS* | *NS* | *NS* |
| Body Condition Score | 3.8 | 3.7 | 3.8 | 3.7 | *NS* | *NS* | *NS* |
| Pellet Intake (kg) | 8.29 | 8.28 | 6.66 | 6.61 | *<0.001* | *NS* | *NS* |
| Milk Yield | 27.64 | 27.4 | 17.81 | 17.02 | *<0.001* | *NS* | *NS* |
| Milk Concentrate (/100kg milk) | 30.73 | 30.9 | 38.66 | 40.05 | *<0.001* | *NS* | *NS* |
| Fat Indication | 4.35 | 4.4 | 4.96 | 5.06 | *<0.001* | *NS* | *NS* |
| Protein Indication | 3.14 | 3.16 | 3.31 | 3.32 | *0.008* | *NS* | *NS* |
| Fat Protein Ratio | 1.39 | 1.39 | 1.51 | 1.53 | *<0.001* | *NS* | *NS* |
| Milk Solids | 2.12 | 2.12 | 1.51 | 1.47 | *<0.001* | *NS* | *NS* |
| SCC Indication | 57.96 | 40.08 | 44.84 | 47.36 | *NS* | *NS* | *NS* |
| **Milking Frequency** | **2.59** | **2.69** | **2.13** | **2.45** | ***<0.001*** | ***<0.05*** | ***NS*** |
| **Milk Refusals/day** | **1** | **2.1** | **0.8** | **1.2** | ***NS*** | ***<0.05*** | ***NS*** |

## Conclusion

Dairy cows offered the diet containing a flavor Plus had a significantly higher milking frequency and attempted to enter the machine on more occasions than cows offered the control feed. The results of this study indicates that a flavor may be effectively used to increase the hedonic value and preference of feed offered to dairy cows in robot milking systems

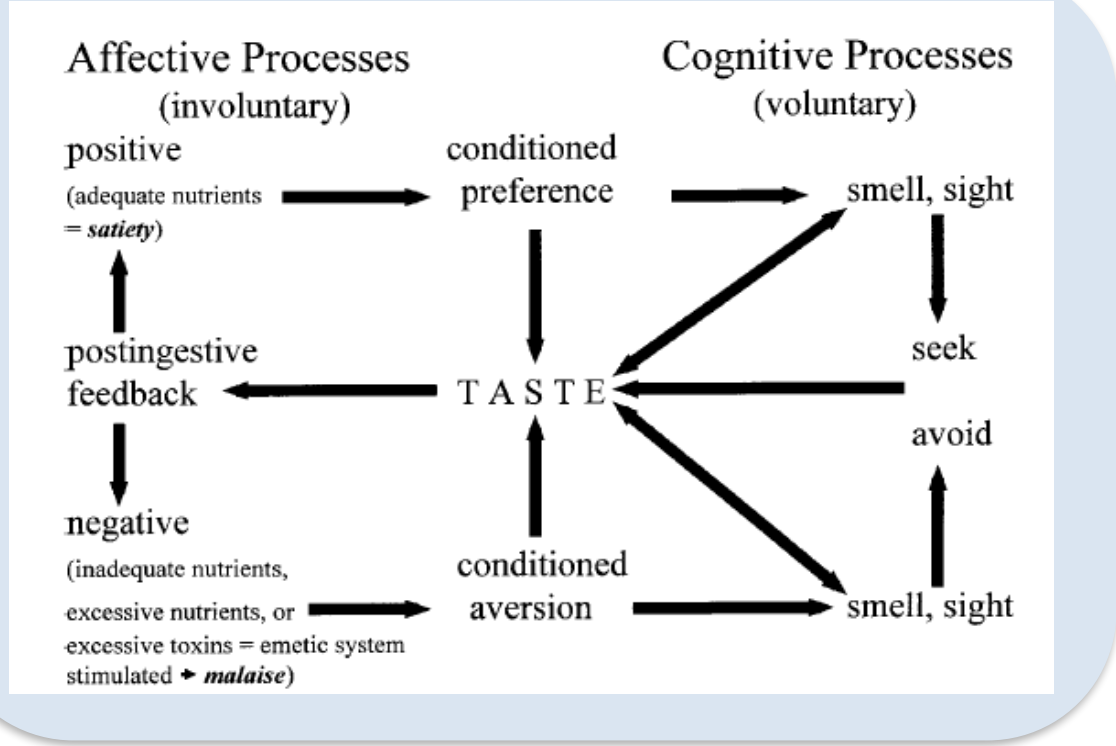


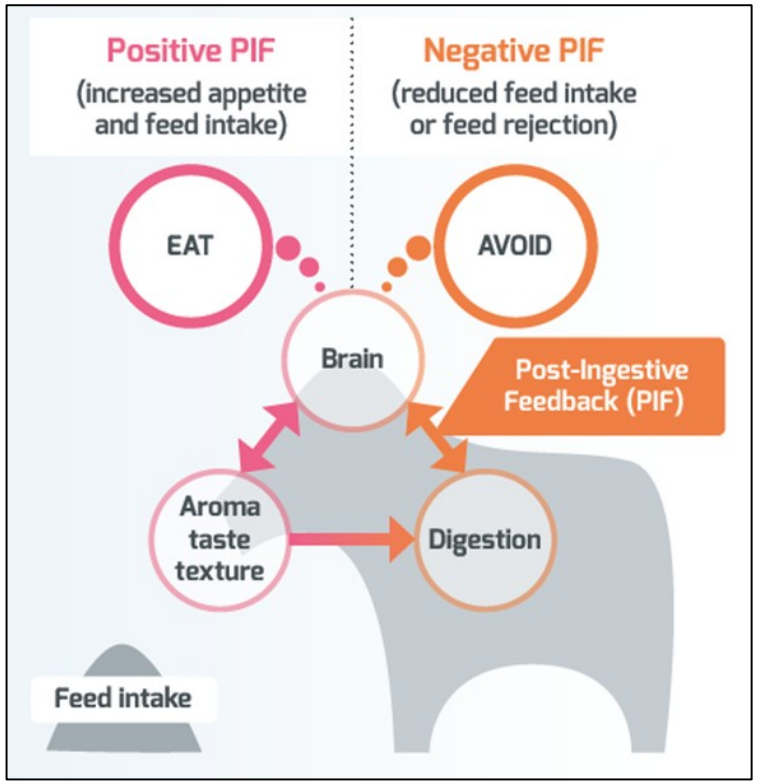



# PALATABILITY INDEX

How to manage palatability in formulation ?

# Why is taste important?




(Adpated from Provenza et al., 1992).

# Assessing the Contribution of Food Ingredients to Overall Dietary Palatability

Will increasing the % of one MP in the formula mask the inappetence of other PMs?

For example, soybean meal is considered an appetizing ingredient, but increasing the level will not mask the inclusion of an unpleasant tasting ingredient such as premix or magnesium oxide.

**If you compare a soybean with a protein feed, with the same value , the palatability will be less.**

**You have to compare pelleted feed with a soya cake + premix + minerals and additives…**

**Table 1 – Bitter components in feed and their impact on feed intake.**

| Non-toxic bitter compounds | Main source | Decrease in feed acceptability |
|---|---|---|
| **Plant derived ingredients** | | |
| Lectins and Kunitz Trypsin inhibitor | Soybean (raw) | High |
| Lectins | Beans – phaseolus (raw) | Very high |
| Tannins | Sorghum | High |
| Fibre components (lignin?) | Oats | Very high |
| Gossypol | Cottonseed meal | Very high |
| Cyanogens | Cassava | High |
| Glucosinolates | Rapeseed meal | Very high |
| Alkaloids | Potato protein, lupins | Very high |
| Non-starch polysaccharides | Lupins | Moderate |
| Chlorogenic acid | Sunflower meal | High |
| Saponins | Soybeans, beans, alfalfa | Low or not consistent |
| **Feed additives*** | | |
| Antibiotics | Pharmaceutical compounds | High |
| Essential oils | Antimicrobial/anti- inflammatory/ antioxidant additives | High |
| Plant extracts | Antimicrobial/anti- inflammatory/ antioxidant additives | High |
| Plant-secondary metabolites | Antimicrobial/anti- inflammatory/ antioxidant additives | High |
| Sucrose octaacetate | Pesticide/Herbicide | High |

*(Adapted from G. Tedo & S. Moraes)*

**This index is based on "ANF synthesis" Study on:**

# Anti Nutritional Factors

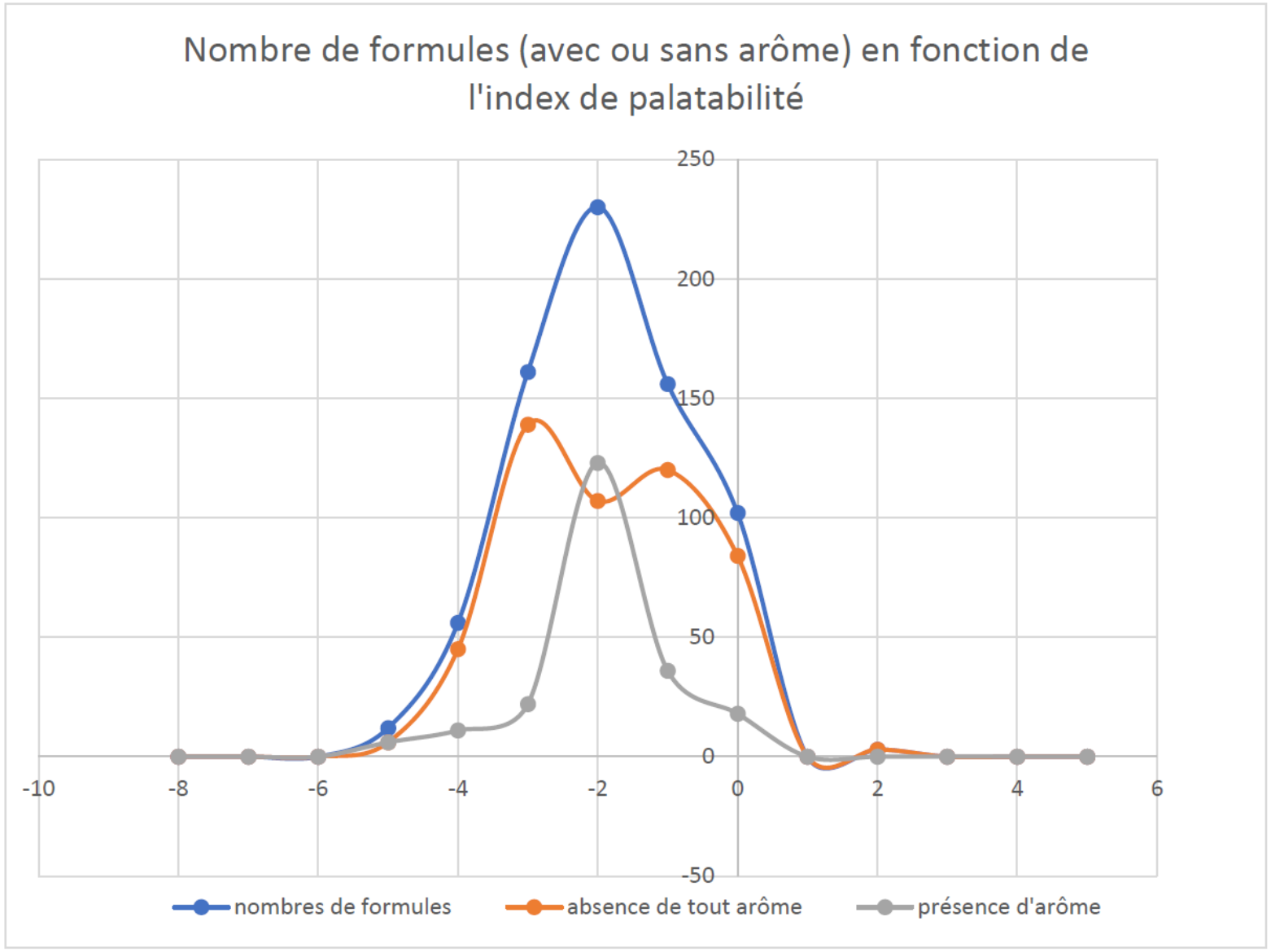
# Palatability Index – 3 Ingredient Classifications


**Aposematic Tastes –** Adaptive strategy (plants or animals) to emit a clearly perceptible signal. Smell and taste are one of these signals. An ingredient that decreases food intake overall or above a certain threshold.

**Agréable au goût/au goût neutre** – An ingredient that is accepted by the animal, with no masking effect or an ingredient at a level acceptable to the animal.

**Palatable/Masking –** An ingredient that is acceptable at any level and can mask deleterious ingredients in the food.

# Palatability Index – concrete example




- Example of a reworked scale with the PAL index
- Cattle range; 970 formulas and 92 MP

# Conclusion

- The natural feeding behavior of the ruminant is part of the performance
- Based on the actual knowledges, we know what hedonic value we have to offer to the animal for best result
- The best formulation is based on values but should integrate the global palatability