



# ANIMAL SCIENCE FACTS

## Palatability and Flavors in Swine Nutrition

Brent Frederick and Eric van Heugten

*Department of Animal Science*

*North Carolina State University*

### Introduction

Many factors affect the amount of feed pigs consume including the energy density of the diet, ambient temperature, immune status, stocking density, sex, genetic heredity, palatability, and flavor. Many of these factors can be controlled by proper management practices. One such practice includes selecting feed ingredients that are highly palatable. Palatability of feed, including taste and texture, refers to the acceptability by the pig and is often quantified by relative responses of feed consumption compared to other diets. Thus, pigs fed diets low in palatability often consume less than if fed diets high in palatability. Therefore, choosing highly palatable feed ingredients and/or using flavor additives to increase palatability may increase feed consumption.

### How are palatability and taste related?

The palatability of a feed is positively correlated to the taste experienced by animals. The sensation associated with eating includes the senses of smell and taste. The sense of smell is often experienced prior to consumption. Therefore, aroma is important as an initial attractant to feed. Groups of cells located on the tongue, commonly referred to as taste buds, are the major sensory organs responsible for taste. Pigs have approximately 19,000 taste buds, which is less than cattle that have 25,000 but more than humans that have 9,000. Therefore, it is likely that pigs' sense of taste is equal to or greater than that of humans.

### How is palatability evaluated?

Studies have been conducted to determine whether or not pigs prefer the taste of a given feed or feedstuff compared to that of another. These studies are referred to as preference studies. Preference studies can be conducted to evaluate a feed ingredient, feed additive, and/or flavor compound. These preference studies are conducted by simultaneously providing both a "normal" or control feed and a feed of interest. Feed intake of each feed is determined. Thus, a comparative indicator of palatability is established by calculating the feed consumption of each feed as a percent of the total intake of both feeds. The feed with the highest percentage of disappearance is considered more palatable than the other. For example, pigs consumed 50 pounds of feed A and 150 pounds of feed B. The total feed intake was 200 pounds of which 25% was feed A and 75% was feed B. Pigs in this example seemed to "prefer" feed B to feed A. Therefore, preference studies are conducted to determine whether a feed is more palatable than another.

Once a feedstuff, additive, or complete feed has been identified as more palatable than others in a preference study, an additional performance study should be conducted. Performance studies

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are used to compare feeds by providing the feed of interest and control feed to different groups of pigs. In this type of study, pigs do not have a choice of feed and must consume one of the assigned feeds. Feed intake and bodyweight gains of each group of pigs are measured and compared during these performance studies. Thus, performance studies are conducted to determine if the feed identified as the “preferred” feed in the preference study actually increases feed intake when pigs are not offered a choice.

Although feed may be preferred in a palatability or preference study, the feed might not increase feed consumption and subsequent growth performance of pigs during performance trials when pigs are not given a choice. Therefore, feed ingredients or flavor additives in a feed need to be evaluated using multiple experimental designs, preference and performance, to determine whether a dietary change will affect feed intake and/or performance. Waste feed should be considered during these experiments to ensure pigs are not simply wasting more feed, which is a common occurrence, associated with low palatability feeds. Furthermore, the efficiency of feed utilization, expressed as the amount of bodyweight gain per unit of feed intake, should be calculated to ensure the increase in feed intake is increasing bodyweight gains as well. Thus, performance studies are recommended to evaluate the effect of a preferred feed on pig performance.

### **Possible benefits of flavor additives**

The dietary transition of weanling pigs from the sows’ milk to solid food is often a slow and non-productive phase of production. Initially, pigs have to identify the formulated feed provided as a food source. Once the feed is identified as a food source, feed intake is limited by palatability. During this period palatability includes primarily flavor, however can be influenced by texture and physical properties of the feed. Strategies to formulate diets to resemble sows’ milk, including the addition of milk by-products, have improved performance during this transition period. However, the addition of these products may not fully maximize feed consumption during the first week after weaning. Therefore, flavor additives have the potential to increase feed consumption during this period through increased aroma attraction and palatability.

Flavor additives may also have a benefit during lactation. Many sows consume less feed during lactation than is required for maintenance and milk production. Lactation demands placed on sows, especially those nursing large litters, result in extreme body weight loss if feed consumption is not adequate. Hot weather will further decrease appetite during lactation, thus increasing weight loss. Although some aromatic sweeteners have not had an effect on feed consumption of lactating sows, the addition of flavor compounds may increase feed consumption and help alleviate lactation demands.

Least cost formulations may incorporate alternative and by-products that provide less expensive nutritional value into the feed but may not be as palatable as what it is replacing. Therefore, flavor additives may increase palatability of feeds and offset the adverse effects on feed intake.

### **Nutritive and non-nutritive sweeteners**

The preference for sweet compounds by weanling pigs is often studied by using water solutions. The preference of pigs for sweet substances is present at birth. Sucrose, a simple sugar, is highly preferred by pigs at concentrations above 10.3 g/L and can increase consumption of water containing sucrose up to 6 times above consumption of water without sucrose. Pigs also preferred water containing greater than 1.8 g/L glucose. However, water consumption decreased when glucose is provided above 21.6 g/L during prolonged supplementation. Therefore, simple sugars appear to be good candidates for supplementation in an early wean, liquid feeding system to increase water and total calorie consumption.

Saccharin, a non-nutritive sweetener, is also preferred at a concentration from 1 to 2 g/L compared to non-supplemented water, but higher concentrations (above 18 g/L) decrease preference substantially. Rejection of high concentrations of saccharin may be due to the bitter taste associated with high concentrations of saccharin. Indeed, when given a choice of non-supplemented water pigs reject bitter tasting compounds such as caffeine and quinine sulfate when supplemented in excessive concentrations. Although sweetened water was preferred over non-supplemented water, neither water consumption nor pig performance of weanling pigs was improved by commercial water sweetener. A strawberry flavor has recently been shown to increase water and feed intake of weanling pigs. Therefore, some flavors may increase water consumption during this crucial time. However, more research is required to conclude whether sweetened water has any effect on water consumption and pig performance.

### **Commercial flavor additives**

One of the most intensive studies that has investigated flavor additives consisted of 248 trials and was conducted to determine the preference for 129 flavors, including flavor combinations from eight major flavor groups: buttery, cheesy, fatty, fruity, green, meaty, musty, and sweet. Of the 129 initial flavors, 2 were selected to be evaluated in a performance experiment. Supplementation of 0.1% cheesy or sweet flavor increased feed consumption and average body weight gain compared to a commercial flavor during the first week after weaning. However, flavor did not affect weekly or cumulative pig performance after the first week post-weaning.

Some commercial flavor additions to growing-finishing pigs (40 to 220 lbs.) slightly increased feed consumption by 1 to 3.6%, although body weight gain and efficiency of feed

utilization were not affected. However, other studies have not indicated that artificial sugar replacers, whey intensifiers, aromatic attractants, vitamin C, apple flavor, or other commercial flavor additive additions affected pig performance.

## By-products and alternative ingredients

Spray-dried porcine plasma (SDPP) has been a relatively new addition to weanling pig diets and has been suggested to increase palatability during the transition from the sow's milk to solid food. Weanling pigs consumed twice as much feed containing 8.5% SDPP compared to 20% dried skimmed milk when offered a choice. The increased feed consumption was due to increased rate of consumption and a trend of increased meal size during the first 21 days post-weaning. However, when not given a choice, feed consumption of the SDPP diets was only increased for approximately 7 days. This supports other studies that indicated feed intake of diets containing dried skim milk was lower than diets containing SDPP. However, after the first two weeks of feeding the dried skim milk dietary consumption increased to that of the SDPP. Thus, SDPP may have an inherent flavor that may increase feed intake immediately after weaning, although other factors that may enhance intake such as immunoglobins can not be ruled out.

Sweet products such as chocolate and chocolate by-products have been evaluated to determine their effects on pig performance. Chocolate flavored whey addition did not affect feed intake or pig growth in weanling pigs when supplemented to replace unflavored whey during the first week after weaning. However, feed wastage tended to be slightly higher when chocolate flavor addition was withdrawn after one week of supplementation. Weanling pigs preferred milk chocolate by-product more than 70% when replacing 5 to 10% of dried whey, but it did not affect pig performance. Addition of 15% or more of the milk chocolate product negatively affected pig performance without substantially affecting preference. Another study indicated chocolate waste product may be included up to 30% in finishing diets without adversely affecting body weight gain or carcass quality.

Insignificant or negative effects on pig performance may be due to the shift from dietary lactose (approximately 70% in whey) to sucrose (30-35% in the milk chocolate product tested) that increases the demand for sucrase, an enzyme required for utilization of sucrose. Lactase activity in the small intestine is high at birth and declines over time while other enzymes, such as sucrase, increase in activity. Therefore, sucrase activity may not be innately adequate for the pig to effectively utilize the dietary sucrose supplementation. Furthermore, the presence of theobromine, a compound similar to caffeine, in chocolate may stimulate the central nervous system and possibly muscle contraction, thereby increasing energy expenditure requiring additional nutrients. Additionally, the sucrose containing chocolate product is replacing lactose in the diet. Thus, chocolate supplementa-

tion does not appear to improve feed consumption or performance of weanling pigs.

Flavors may also increase the palatability of feeds containing ingredients, which are not naturally accepted by the pig. Canola meal may be included as an alternative to soybean meal in pig diets. However, dietary inclusion of canola meal is limited partially by the palatability of the feed. Although flavor additives may increase feed consumption of diets containing up to 18% canola meal versus diets without flavor, feed consumption of flavor diets decreased when dietary canola meal inclusion increased up to 100% replacement of soybean meal. Thus, flavor enhancement of certain by-products may allow for increased inclusion rates of presently utilized feedstuffs and by-products.

## Conclusion

Feed intake seems to be regulated more by physiological factors than the taste of the feed. However, the strategic use of flavors may be beneficial under certain conditions. These include: 1) the first week post-weaning when the pig is in a dietary transition from the sow's milk to solid food; 2) during times when changes in diet formulations are made; 3) during times of heat stress and 4) to mask the taste of relatively low palatable dietary ingredients.

## Suggested readings

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