RESEARCH REPORT
INTERNATIONAL TRADE

Title: Pork offal bone literature review and industry survey – NPB #15-201

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Industry Summary:

The ability of the pork industry to enhance profitability is best found through the utilization of low value products that are not commonly accepted for consumption in the United States, ie offal products. Recent analysis has indicated great potential to add value to pork if offal and specifically variety meats can be exported. The goal of this project was to conduct a literature review to determine what information currently exist related to the utilization and optimization of US pork offal bones for utilization in foreign. A review of literature was conducted across both scientific and trade journals to determine previous research/ analysis conducted. This review found minimal previous documented research/ analysis conducted. In addition, while interest/ current export practices among packers/ processors varied greatly, the opportunity to explore such markets around the globe with a variety of pork bone products exist and could be economically advantageous, especially to innovative processors.

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Scientific Abstract: Pork offal bone byproducts are highly acceptable in many of the global markets outside the United States and may be widely utilized, and may provide essential nutrition in human diets. Animal bones can impart a variety of flavors and textures to food products while increasing the nutritional value of the food (Lui, 2002). In Southeast Asia, offal including many offal products are often consumed (Lui, 2002). Recent conversations with many processors have indicated that the greatest challenge to utilization of pork bones exist in the added value proposition. Limited research exists outlining pork bone utilization, although "common knowledge" seems to indicate that global utilization of these products is vast for soups, stocks, flavoring, nutrition, etc in most countries outside the United States. This lack of research and the opportunity to add further value to pork suggests that further work is needed to better understand the utilization of pork bones in an export market program, thus enhancing both overall pork value, especially in light of the interest by processors to increase this market.

Introduction: A recent regression analysis showed that for every $1 million of muscle meat exported, live hog value increases by $0.05/CWT but for every $1 million of variety meat exported, live hog value increases by $0.20/CWT. The US pork industry produces more than five million metric tons of pork variety meats and pork by-products each year, yet it exports less than a half million metric tons of these products. This suggests that a significant portion of US pork carcasses are currently rendered to make blood meal, meat and bone meal, fat and grease. These rendered products are all of low value but are often highly valued in specific countries and in many cases sell for price premiums that are many multiples of the US price. Also, consumers in many target countries often lack adequate, high quality protein in their diets. The elimination of a price wedge between the US and international prices would allow these consumers to purchase products that are highly valued in local cuisine and, in so doing, increase the nutritional value of their diets. The removal of this price wedge would also increase the value of live hogs in the US and reduce the breakeven cost of producing muscle meats for the US consumer. The desire to enhance pork value although laudable, is difficult to achieve in an industry that has already taken advantage of most opportunities to add value in the muscle products as well as many by-products. However, the opportunity to add value to export products not normally consumed in the US offers a unique opportunity to the US pork industry. Pork offal, especially bone items, a rich and economical source of essential nutrients, are underutilized and even detrimental to value in many situations. Although the meat industry employs several practices to merchandize bones, only a few of them have been adapted for use in by-products due to the product's value. Thus, issues still exist for variety item export meats due to concerns about profitability and market share. Currently, there is little information available for best management practices that exist to optimize value of bone utilization, especially for export. The current study will attempt to better understand possible methods of optimization on pork bones for use in the export market

Objectives: The objective of this proposed project is to:

- Conduct a literature and industry review of the past, current and potential future processing of pork bones destined for export to determine optimal value reclamation of these items.

Materials & Methods: Industry survey and Database Search

Eight to twelve industry executives will be selected for survey. Once selected, each will be surveyed about knowledge of previous, current and potential future bones product processing, market and utilization including profitability. A standard survey will be developed for distribution in an attempt to garner consistent informational sources.

The data base literature review will include a literature search in Web of Knowledge, which includes the following databases: Web of Science, BIOSIS Citation Index, BIOSIS Previews, CAB Abstracts, Current Contents Connect, Data Citation Index, Derwent Innovations Index, MEDLINE, Zoological Record, and Journal Citation Reports. The search string will be designed using the terms/ phrases that related to the pork bone utilization and marketing. Further refinement will be conducted as initial results indicate database tendencies.

Results:

Collagen protein accounts for 60% of body proteins and 30% of hogs' total organic body mass (Ockerman & Basu, 2006), while bone makes up 11% the mass of a pork carcass (Lui, 2002). Pork hides and bones contain large quantities of collagen. Collagen is comprised of monomers of tropocollagen, arranged in a triple-helix of coiled peptide strands (Ockerman & Basu, 2006). Gelatin is formed when the hydrogen bonds of the collagen triple helix are destabilized, resulting in configurations of random coils (Ockerman & Basu, 2006). The properties of the native collagen and the degree of cross-linking of the collagen influence the properties of the processed gelatin (Ockerman & Basu, 2006).

Collagen extraction from pork bones generally results in Type A gelatin (Ockerman & Basu, 2006). This process involves washing the raw material and pre-extracting fat with heat and nonpolar chemicals; soaking the bones in inorganic acids followed by washing to raise the pH; treatment with alkaline materials; filtering and drying; and finally a series of cook steps and re-drying (Ockerman & Basu, 2006).

Gelatin formed from collagen is high in the amino acids glycine, lysine, proline and hydroxyproline, but low in tryptophan and methionine (Ockerman & Basu, 2006). When derived from USDA inspected animals, gelatin is considered an edible product (Ockerman & Basu, 2006). Therefore, gelatin can contribute nutritionally to the diet, but cannot be a sole source of protein because it lacks some essential amino acids. This is especially important because lysine is the first limiting amino acid in cereals (Subba, 2002). Gelatin can be added to desserts and jellies as well as meat products, and can be used as a stabilizer in ice cream, preventing the formation of ice crystals during storage (Lui, 2002). Gelatin can also be added to meat products as an emulsifier due to its fat-binding capabilities (Lui, 2002). Additionally, recent novel uses of collagen hydrolysates include clarifying food products, stabilization of solutions and protective coatings (Djagny, Wang & Xu, 2001; Gomez-Guillen et al., 2011).

Collagen has been identified as a source of bioactive peptides, short sequences of amino acids that can influence the physiological functioning of humans (Saiga et al.; 2008, Toldra et al., 2016, Spain). The sequences of, usually, 2 to 20 amino acids derived from collagen hydrolysates, have demonstrated ACE-inhibitory and antioxidant capabilities (Saiga et al., 2008; Toldra et al., 2016, Spain) as well as preventing heart disease and promoting healthy heart function, alleviating symptoms of mental illness and combating obesity (Tomas & Maria, 2014). Collagen hydrolysates may hold promise in counteracting the accumulation of osteoarthritis in joint cartilage (Bello & Oesser, 2006). Additionally, gelatin derived from collagen is a key binding agent in the outer coverings of medicinal capsule and tablets, and 6/5% of gelatin is utilized by the medical industry for this purpose (Hidaka & Liu, 2003).

Many regionally-popular foods, specifically from Asia, utilize pork bones as a critical ingredient. Ramen dishes have gained huge popularity in Japan as a trendy and innovative food, with hundreds of restaurants dedicated to serving the pork bone broth-based soup (Fifield, 2014). Though the ramen trend may have reached its apex in Japan (Fifield, 2014), the number of up-scale ramen restaurants in European and American cities is increasing (FoodCentric, 2014). Fast-casual Japanese-style restaurants are expanding in number in these regions, offering brunch, lunch and dinner menu items (FoodCentric, 2014). The recent trends toward more adventurous home cooking may open another avenue for utilization of pork bones, as popular recipe websites promote recipes that feature pork bone broth-based soups, including Tonskotsu Ramen (Ping, 2015), Chinese Paigu Luobo Tang Soup (www.food.com, 2011), and Gam Ja Tang, Korean Pork Bone Soup (Oliver, 2016). Moreover, chicken bone concentrate is commonly used as a flavoring in Asian countries and is added to noodle products, sauces,

stews, curries, hams and sausages and also as a soup base (Lui, 2002). Traditionally, chicken bone concentrate is made by cooking crushed chicken bones for 8 to 12 hours, resulting in a liquid that contains 5% solids (Lui, 2002). Novel processing methods utilizing high pressure extraction can shorten processing time to 1 to 2 hours, generating a liquid with 10% solids (Lui, 2002). This process could be replicated with pork bones to produce a concentrated flavoring liquid.

Pork bone byproducts have been a component of livestock feeds as meat & bone meal, with is a good source of amino acids and B vitamins (Jayathilakan et al., 2012). Protein hydrolysates of meat byproducts generally lack allergenic proteins and other antinutritional factors, and should therefore be considered as an alternative to soybean meal in some specialized feeding opperations (Martinez-Alvarez et al., 2015).

Industry Survey

Much interest exists among processor respondents related to processing bones for export. While concerns are related to the cost versus benefit ratio, most processors see this as a great opportunity to add value. The global use of these items for soups, stocks, flavoring and in retail and foodservice markets suggest the demand for a cost effective product is potentially available.

Discussion:

Pork offal, specifically variety meats/ bone items, are the last frontier of value-added merchandizing to explore from the highly value-added porcine animal! If the recent scenario presented that indicated for every $1 million of variety meat exported, live hog value increases by $0.20/CWT and the industry exports less than 10% of these products then a tremendous economic opportunity exist for the US pork industry. As the US pork industry searches to capitalize on this little valued by-product that the majority of the world has commonly accepted as a readily consumable animal protein source, it needs only determine a way to assure the safety and extend the shelf life of products destined for export. This added value to a current low value byproduct with little future for enhancement in the US market will allow for a greater return to the entire pork value chain by providing a substantial demand in pork exports.

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