

# Bacon Quality Evaluation Methods

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Bacon consumption has gone from a declining "Center-of-plate" breakfast market to an ever increasing component of other food such as burgers, chicken breast sandwiches, salads and ingredient in a variety of prepared entrees as well as the traditional breakfast market. Lay-out bacon for the food service industry continues to be popular and grow. The exciting, fast growing new markets include the pre-cooked bacon for both the food service and the retail market. This increased emphasis has reversed the market for fresh bellies from the vast surplus of bellies during the low prices period of the past several years to a point where the raw belly competes with more traditional primals for high value today.

This Reciprocation session will look at the problems and opportunities to evaluate bacon with different measurement procedures particularly focused on quantitative and qualitative evaluation of the lean and fat. Color of the lean as well as the fat captured through visioning equipment, problems associated with the highly variable raw material and defects will be discussed. The discussion is based on extension bacon research developed for the National Pork Producers Council (Des Moines, IA). The discussion will center on some of the unique challenges of bacon processing under research conditions and the need to develop new evaluation procedures. The bacon for this study originated from the NPPC Quality Lean Growth Modeling project involving 1588 pigs in a design that included 3 slaughter weights, 6 genetic lines, four lysine levels, barrows and gilts. That information will not be discussed at length or included in this Reciprocation Session.

## Where to sample bacon?

Bacon made from the pork belly has a few prominent, yet thin, wide, fan-like muscles, characterized by four major muscles and compounded upon by the workmanship of sparerib removal, and trimming, sometimes to "rob" lean for

high value alternative uses. The problem of sampling site is magnified by the range of belly weight, belly thickness and the belly length/width dimensions. A sampling plan to standardize sampling location is offered (Table 1). This plan divides the bacon slab into 5 zones [A, B, C, D and E], each representing 20% of the bacon slab. Each Zone is further divided into quadrants representing 25% of the slice width starting with quadrant 1 nearest the dorsal line where the loin had been removed and continuing through quadrant 4 representing the belly midline or where the teat line had been removed from the belly prior to curing. Thus these 20 specific parts of each belly can be related to all bellies regardless of dimensional changes. The first 1 or 2 or more slices can be removed from each zone for further analyses such as camera visioning, proximate analyses and cooking studies. Good confidence is had that all samples are from reasonably the same location in each belly.

## Bacon Shattering?

The term shattered bacon was defined as the length of individual shatter marks perpendicular to the slice found in the fat of the sliced bacon. A frequency distribution was determined for the zones and quadrants. Extent of each shatter mark was measured in mm and grouped as none, 1-10, 11-20, 21-30, 31-40 and 40+ of two slices taken from each zone of the bacon slab. These two slices were subsequently used for the visioning and finally for proximate analyses.

## Camera Visioning?

Camera visioning to capture pixels of information was adapted to capture the image of two (2) bacon slices. The visioning system involves a RGB (red, green, blue) image of each pixel in the screens. A system of 8 lean colors, 3 fat colors and the black background were developed using panels of technicians and faculty looking at bacon and agreeing upon colors which were characterized for RGB which the computer could summarize. This procedure was used to quantitatively determine the amount of lean and fat in each slice or specific muscle within the slice. The computer could further be by the pre-determined color groups.

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Proceedings of the 54th Reciprocal Meat Conference (2001)

**TABLE 1.** Sampling Diagram for Draft of Sliced Bacon

Anterior	Dorsal					Posterior
Incomplete Slices	A	B	C	D	E	Comb End
Quad 1	-> 123456...	-> 123456...	-> 123456...	-> 123456...	-> 123456...	0 0 0
Quad 2						0 0 0
Quad 3						0 0 0
Quad 4						0 0 0

Ventral

### Cooked Bacon Evaluation?

Two bacon cooking procedures were developed to evaluate the performance of the sliced bacon from this project. A double belt cooking system [Magic-Grill (PGB-60), Quakerstown, PA] using a teflon belted conduction heating conveyor was one system and a second system, a microwave cooking system, using a Litton Microwave oven (Menumaster70/80 with 2000 wt power; Litton Industries, Minneapolis, MN) and belting used in commercial microwave oven placed in microwave trays (Anchor Hocking, St. Paul, MN) were developed. The criteria that comparable doneness, color of fat and lean and cooked yields of five slices per test was required of both systems. Cooking systems for pre-cooked must yield cooked bacon with less than 40% yield according to USDA regulations for precooked bacon. The two cooking systems were tested on a variety of bacon types to validate that the cooking systems complied and then cooked yield from both systems was collected on a five slice sample for each of the bacon slabs at each of the 5 zones from the slab. A distortion scale for cooked bacon was also developed with a five point scale with one as flat cooked bacon to 5 as severely distortion.

### General Conclusions

Challenges encountered in the processing of the widely variable raw bellies were partially overcome by the special processing procedures developed. The issues of where to sample seem to be covered by the procedures developed. Results of the procedures developed for shattering appear to work, the data are still being evaluated and interpreted.

Camera visioning procedures developed worked well and good quality data were obtained on color of the lean and fat as well as the amount of each. Camera visioning for cooked bacon is the next step and under study at this time. Data related to the original statistical model for the project for design parameters are analyzed and differences in the genetic lines, sex, diet and slaughter weight effects were found and have been analyzed, although not discussed during the Reciprocation Session.

Discussion following the presentation during the question and answers period were good and reflect current issues found at several levels of the live pork industry as well as the processing industry. The issues that reflect of better bacon for retail and food service consumers focus on consistency, increased leanness, color stability and uniformity and the role that cooked bacon continues to play as an enhancement for entrees from sandwiches to center-of-plate up-scale meals. Bacon tastes good and brings to many other foods high consumer satisfaction as an important contributor to flavor, texture of meal satisfaction.