LEVERAGING HISTORICAL SENSORY ASSETS TO INFORM RESEARCH STRATEGY: A META-ANALYSIS STUDY ON FRESH CHICKEN

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Introduction

It is commonplace in industry and academia to pour thousands of dollars and years of research into descriptive analysis studies for one product category. Typically, these studies are designed to address specific research objectives. Individually, they provide great value, but when combined, they can yield even more valuable holistic insights about the category.

Perdue collected Descriptive Analysis profiles on a number of fresh chicken samples through distinct descriptive analysis studies conducted between 2015-2022. These studies varied in project objective, number of samples, muscle type evaluated, preparation methods, and sensory modality measured. Despite these variations, a meta-analysis of this dataset uncovers trends that correlate the sensory attributes of fresh chicken with factors that vary between the studies.

Objectives

1) Understand links between sensory properties of fresh chicken samples and the following variables related to production and/or evaluation procedure:

- ❖ Chicken Breed
- ❖ Chicken Diet/Feed
- ❖ Muscle Type (breast, thigh, breast/thigh combined)
- ❖ Evaluation Procedures (skin on/skin off)

2) Leverage findings to inform Perdue's ongoing research strategy for fresh chicken.

Method

Descriptive Analysis – Spectrum Method:

126 Samples taken across 37 distinct studies between 2015 and 2022

- Study procedures varied in the following:
  - Number of samples per project (1-10)
  - Muscle type evaluation – breast only, thigh only, breast & thigh combined, breast & thigh separately
  - Presence /absence of skin in evaluation
  - Preparation - whole bird, breast bone in, breast boneless, thigh bone in, thigh boneless
  - Evaluation method – consensus/individual, and sensory modality (Flavor Only, Texture Only, Both)
- All chicken samples were cooked on foil lined baking sheets in ovens preheated to 350°F until an internal temperature of 165°F

Meta-Analysis Approach:

Data Aggregation
- Sensory data consolidation – based on commonly evaluated attributes (made possible by use of Spectrum Method DA)
- Critical sample information – clarified & augmented based on input from Perdue

Summary of Sensory Information
- Sensory data are summarized using commonly used statistical methods (descriptive statistics, factor analysis…)

Mining Data for Insights
- Resulting database can be queried for insights across multiple studies or within each study
- Visualization techniques are selected to most appropriately answer research questions (perceptual maps, box plots…)

Results: Key Areas of Differentiation Between Samples

from Factor Analysis

Flavor

Low → High Flavor Strength, Poultry Complex *[8% of variability]*	Lean Meat → Dark Meat (Bone Serum/ Fat/ Skin, Organ), Sweet *[36% of variability]*	Low → High Roasted Skin / Caramelized Notes *[8% of variability]*
Low → High Sour & Silage *[8% of variability]*	Not Salty → Salty *[15% of variability]*	Low → High Umami & Metallic Feel *[7% of variability]*

Texture

Surface: Low → High Rough and Oily *[11% of variability]*	Surface: Moist → Dry *[9% of variability]*	Soft First Bite, Chalky Chew → Hard First Bite, Fibrous Chew *13% of variability]*
Springy First Bite, Lumpy Chew → Uniform First Bite, Grainy Chew *[12% of variability]*	Low → High Moist & Juicy with Oily/Greasy Mouthcoat *[13% of variability]*	Loose & Rubbery → Cohesive & Mealy *[13% of variability]*

Partial Results: How Meta-Analysis Can Shed Light on Some Internal Wonders

How does evaluating breast vs. thigh or cooking samples with and without skin impact the sensory experience?

Results across evaluation procedures highlight **sensory characteristics most likely impacted by preparation method** (skin off / skin on) and **muscle type** (breast vs thigh) on which the evaluation was performed.

Only partial results are presented as examples, although meta-analysis yielded more insights.

In Figure 1, **breasts** and **thighs** offer clearly different chicken character. Samples prepared with Skin On trend toward stronger roasted / caramelized character. These differences are more strongly seen in breast than they are in thigh evaluations.

Opposite Figure 1, Figure 2 demonstrates that **preparation method (skin off / skin on)** and **muscle type (breast vs thigh)** result in little systematic differences in first bite (soft vs. hard) and chewdown characteristics (Loose & Rubbery vs. Cohesive & Mealy; Chalky vs Fibrous).

Differences in these characteristics are most likely explained by other factors.

Fig. 1: Impact of Preparation (skin off/on) and Muscle type (Evaluation on breast vs thigh) on Poultry Character & Roasted/Caramelized Notes

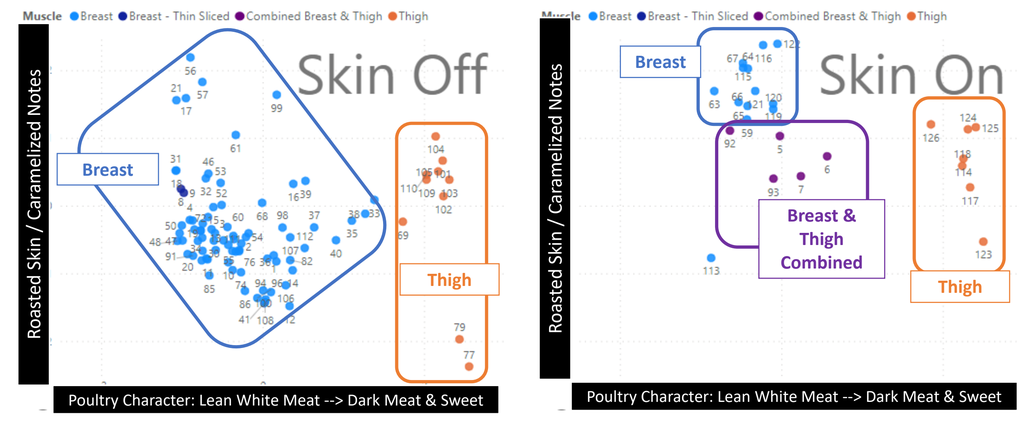
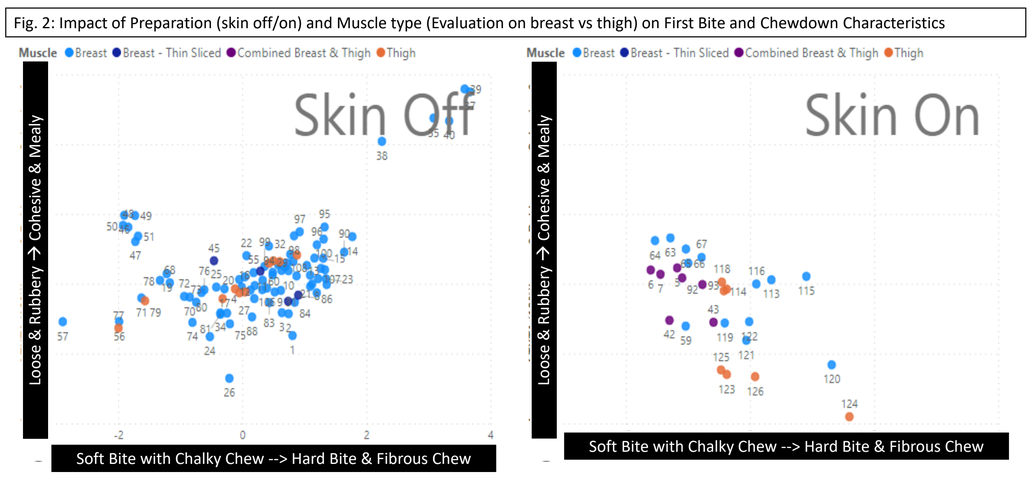


Fig. 2: Impact of Preparation (skin off/on) and Muscle type (Evaluation on breast vs thigh) on First Bite and Chewdown Characteristics



Beyond differences in procedure, what is our current knowledge on sensory variability among breed? [partial results from 8 studies focused on breed]

Once variability in preparation and evaluation procedures is clearly understood, meta-analysis can be leveraged further for insights on status of the research program. A key question in this study was to summarize knowledge to date related to various breeds of chicken. Figures 3 and 4 provide partial insight on that knowledge.

Examples of findings include: in skin off conditions, **Breed C Mini** is consistently higher in Roasted Skin Characteristics than **Breed H** and **Breed B** while **Breed A** is midrange (Figure 3). This is seen both in evaluations on breasts or on thighs, although differences are greater in breast evaluations. From a texture standpoint, **Breed C & C Mini** are likely associated with a softer first bite and a chalkier chewdown than **Breed B or H** (alone or in cross breed) (Figure 4).

Similarly, in skin on conditions, **Breed D*Breed K** is harder and more fibrous than **Breed J** or **Breed L**. Impact of **Feed (A vs B)** is small on these characteristics in comparison to impact of breed (Figure 4).

Fig. 3: Impact of Breed on Poultry Character & Roasted/Caramelized Notes

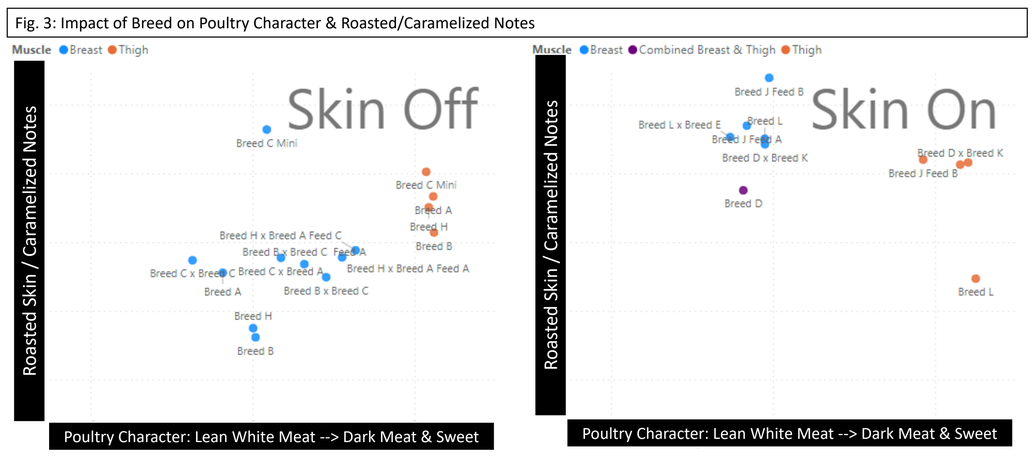
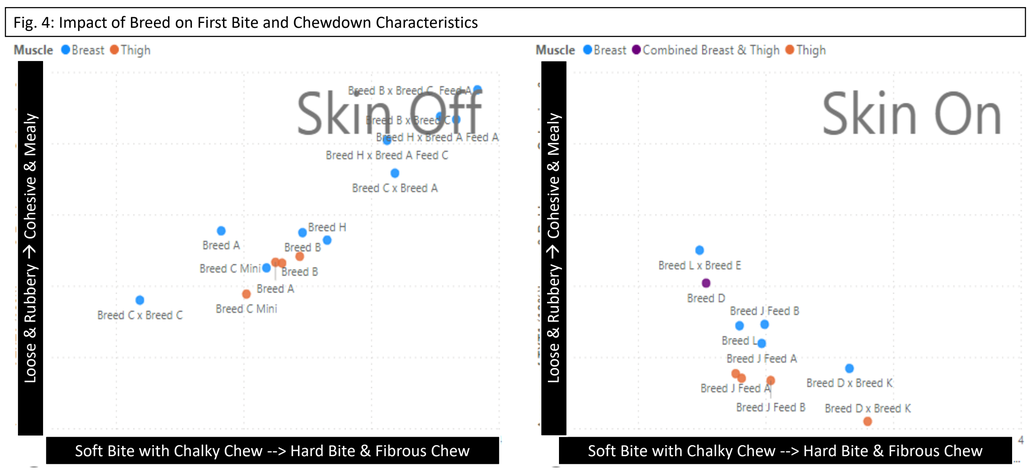


Fig. 4: Impact of Breed on First Bite and Chewdown Characteristics



Additional insights from data mining

- Several studies showed some differentiation in terms of flavor and texture among the different breeds beyond those presented in Figure 3 and Figure 4. (Data not shown)
- Studies focused on breed/diet suggest that breed may have a larger impact on sensory features (especially texture) than diet.
- Within a breed, diet is more likely to impact flavor than texture.

Key Insights, Impact and Conclusions

Through a meta-analysis approach, results from multiple studies were combined to create universal sensory maps and uncover sensory insights. Careful consideration was given to **understanding and accounting for the variability in methodology** over time and across multiple studies.

Accounting for the impact of methodology on sensory characteristics was critical to **uncover insights on breed and feed**, both of which are important areas of focus for Perdue's research program. **Gaps in knowledge were identified** where additional research is needed. Findings further informed **prioritization of those development and research initiatives** most likely to have the greatest positive impact on Perdue's overall objective: providing consumers with better tasting fresh chicken.

Another outcome of this overview of past research is the definition of **more standardized and systematic study protocols**. The design is expected to maximize sensory insights within each study, and allow for more robust comparisons across studies, ensuring **each sensory research dollars spent yields greater more valuable insights**.

In general, leveraging historical descriptive analysis assets can yield valuable insights for organizations with long running sensory programs. Meta-analysis uniquely **highlights opportunities to refine evaluation methods, provides preliminary information on internal questions, and identifies gaps in knowledge**. Such insights can be used to **inform future research strategies** and help prioritize research initiatives, which will **augment the body of knowledge** and provide a more **complete understanding** of the category over time.