



**Fields of Gold Consulting LLC**

*Optimized Food, Process and Flavor Development*

# “Modeling Healthier Whole Grain Food Products.”

2nd Annual Research Preview Minneapolis 9/15-9/16

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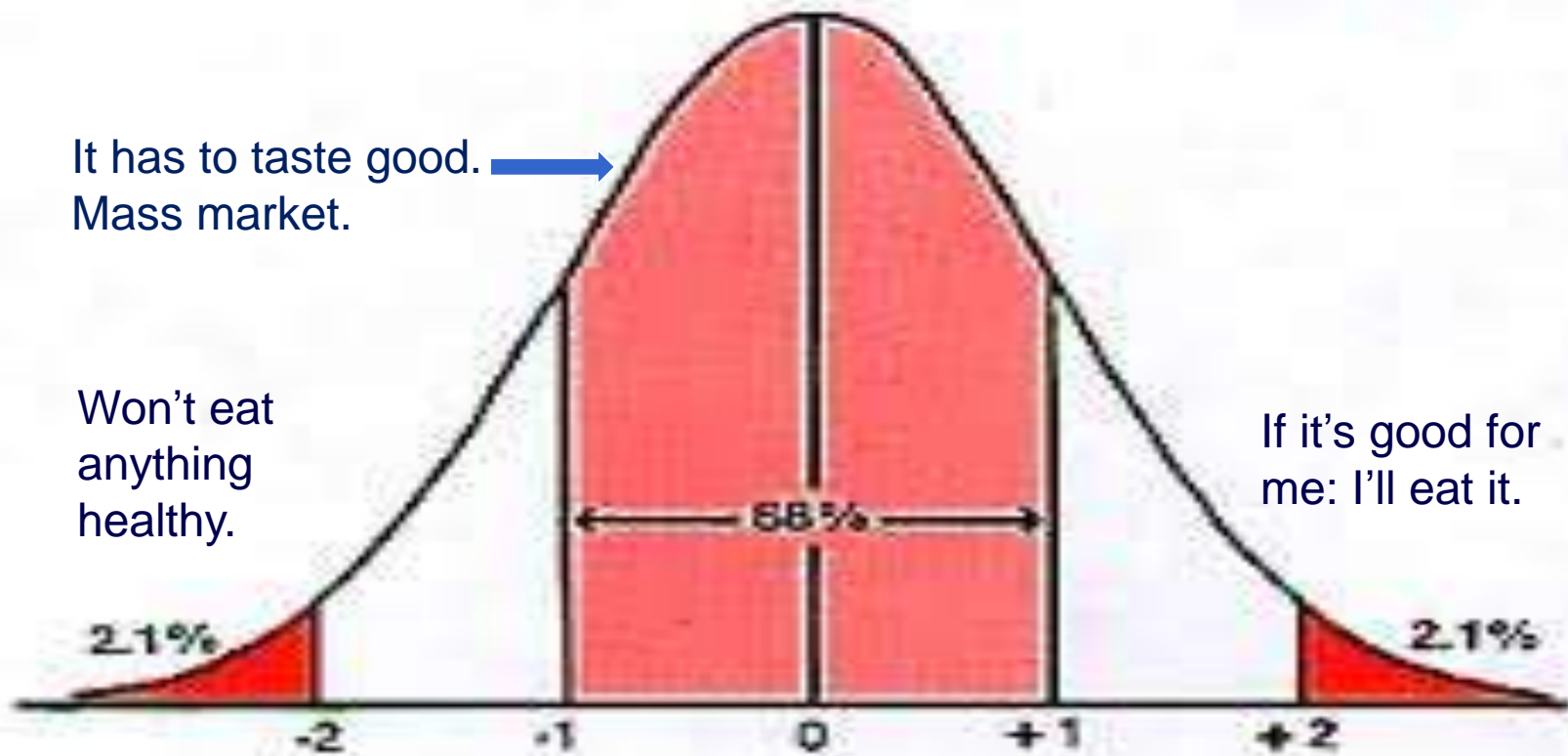
# Agenda

- The Goal / Background
- Current Product Development Practices and Outcomes
- Interactions – Magic for Products
- Improved Methods for Development / Modeling
- Some market predictions...
- Wrap-up / Questions

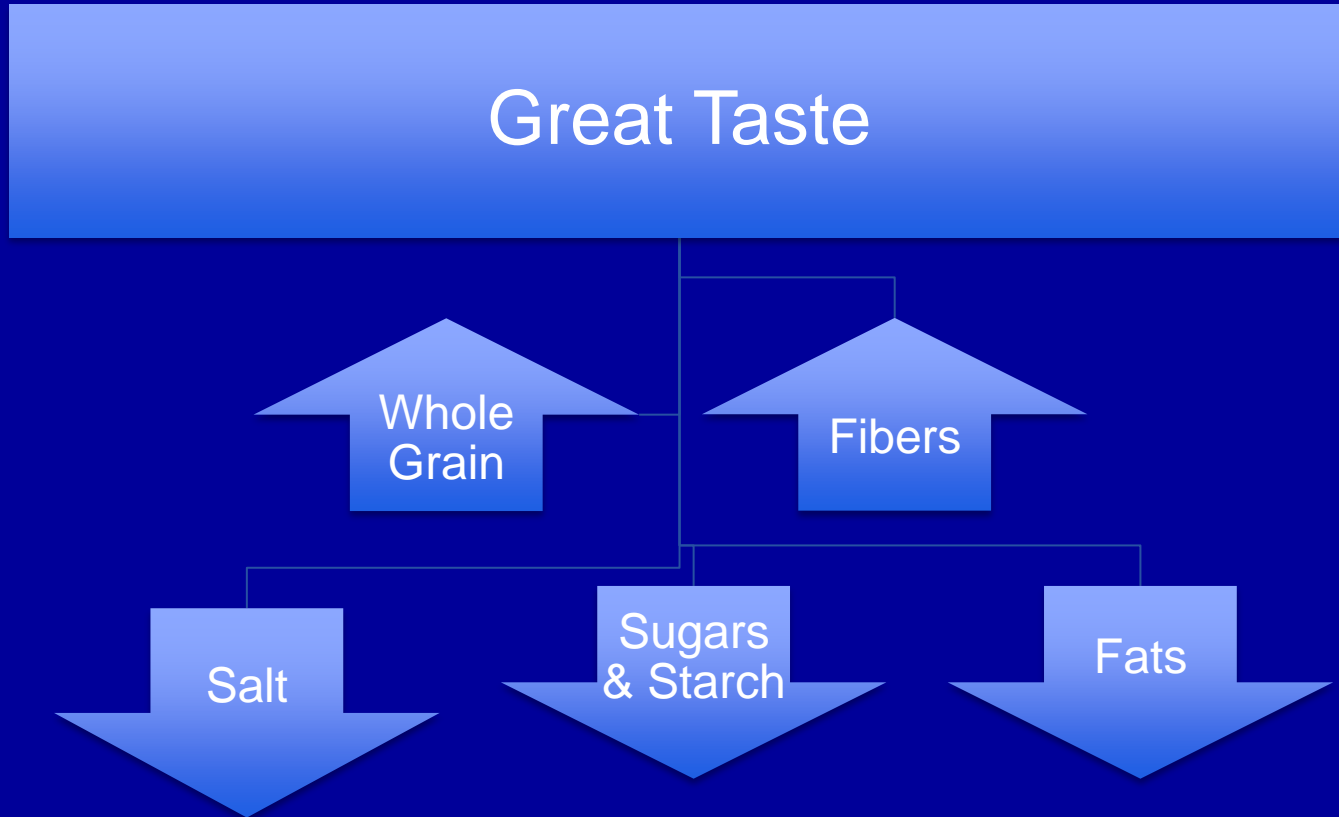
# The Goal

- Create healthy new foods that taste great.
  - High whole grain, low fat, low sodium, high fiber, low sugar.
  - Cost and processability need to be considered.

# The Bell Curve of Customer Reactions



# The Cast of Materials



Assumption: There exists a way to use these materials in a way that pleases customers.

(At least we can find the best compromises and the “drop off” points for mass appeal for each ingredient as well as combinations!)

# Current Practices in Product Development

- Trial and Error Rules
- Materials are substituted one at a time at various levels
  - Product changes
- “Negative learning” can occur
  - Fibers don’t work
  - Lower salt is bad
  - Whole grain adds bitterness

# Process Continues

- May try “new technologies”
  - Salt replacers, etc..
  - New processes
- Very little accumulation of knowledge in the process



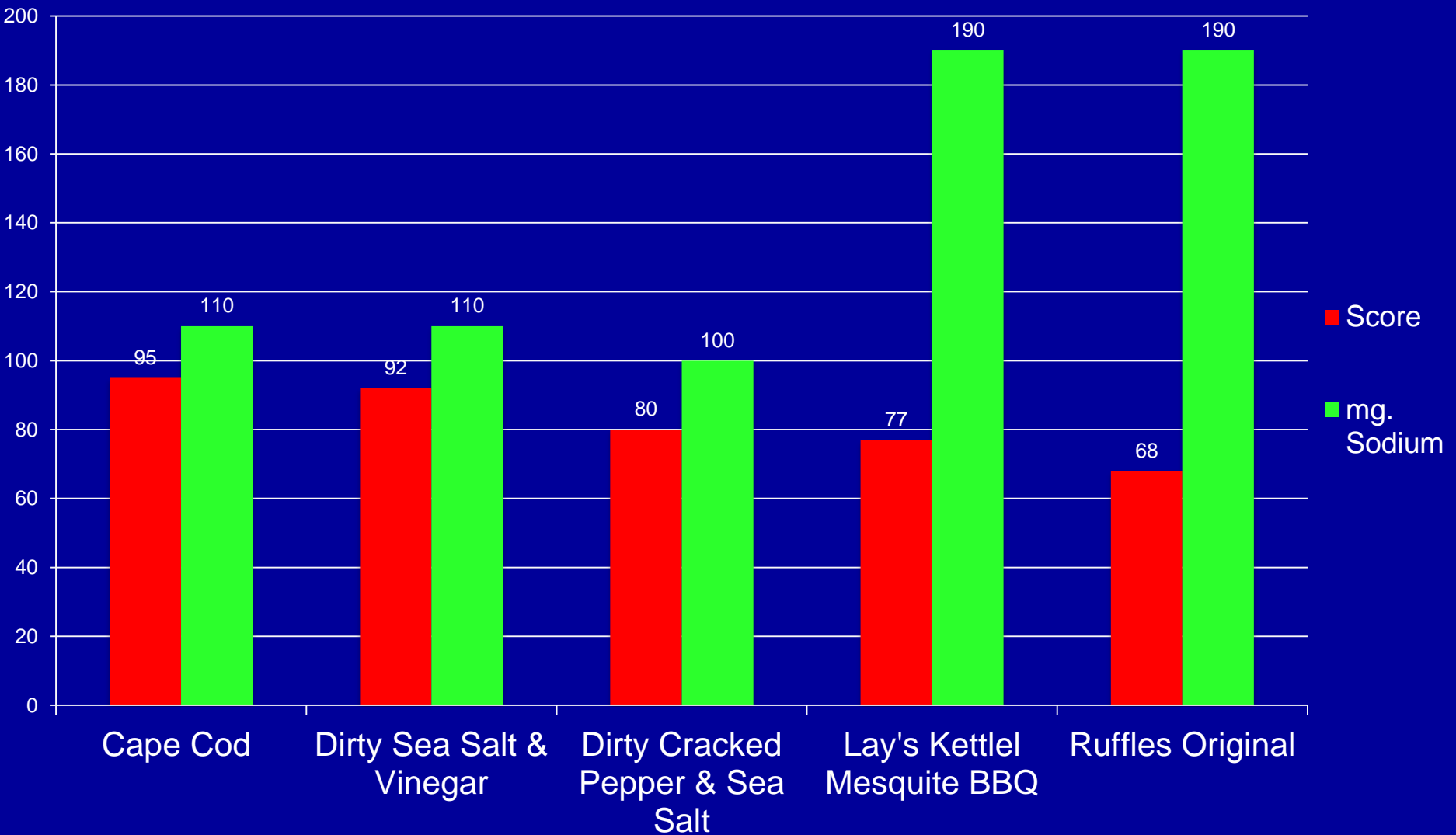
# Current Process Outcome

- Trial & error continues until a product “wins” on a consumer test
- Seldom optimal for cost, health, and liking but “good enough”
- Close to “typical” or traditional levels of ingredients
- New products often reformulated soon after launch

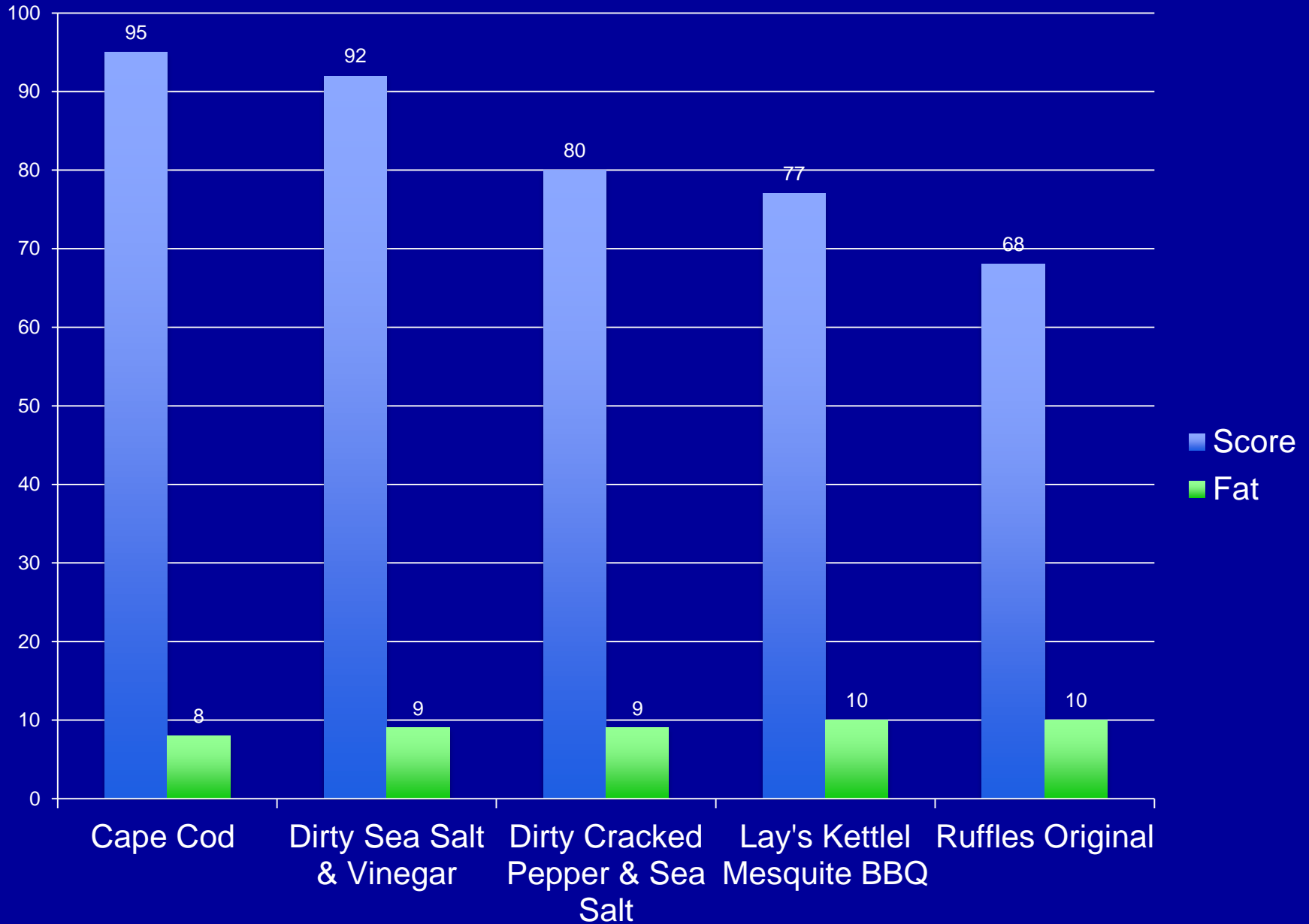
# Real Products

- Snacks and Beverages
  - Often target of blame for empty calories, sodium etc..
  - Are high levels of sugar, salt, fat etc.. necessary for consumer acceptance?

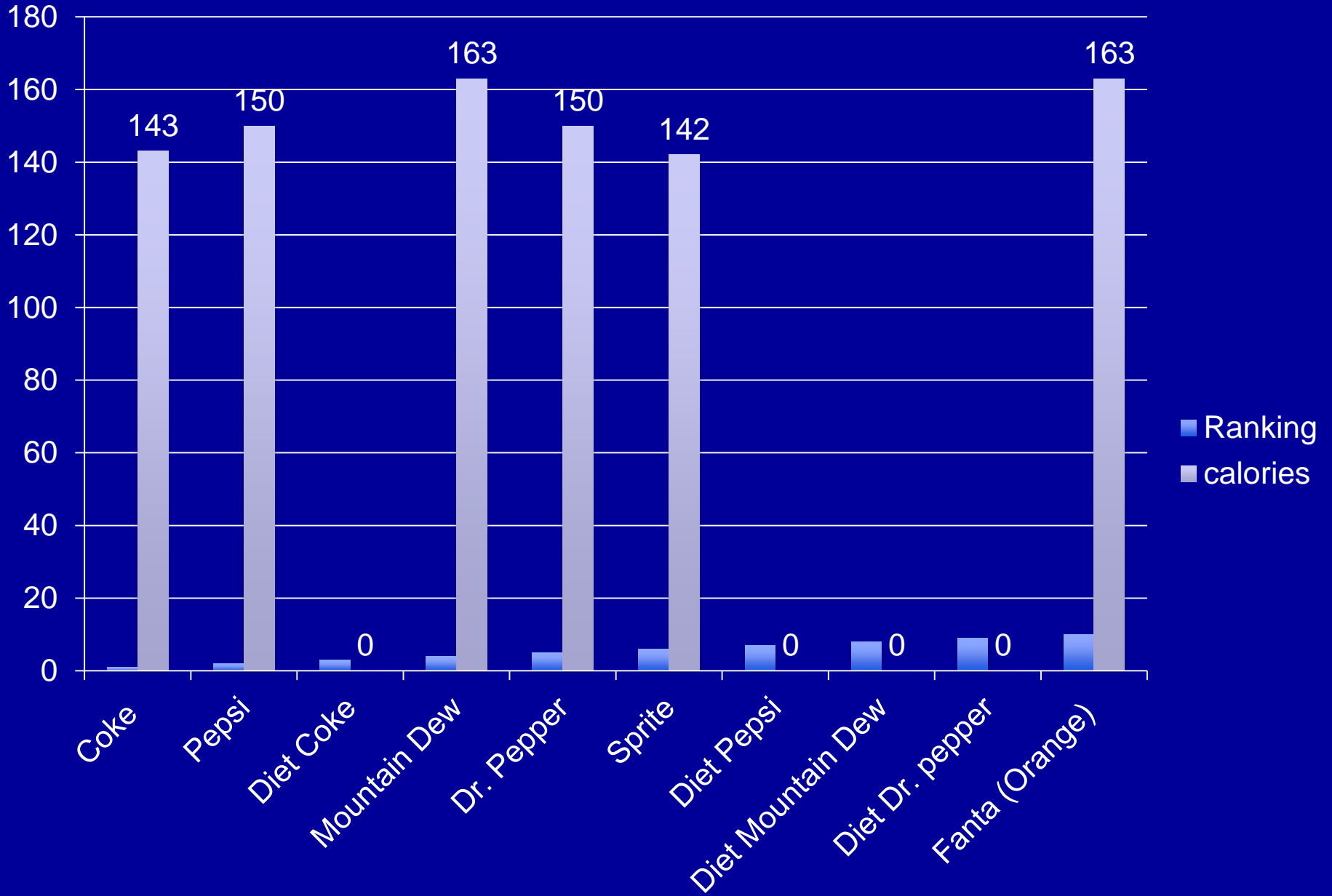
# Preference vs. Sodium Content for Potato Chips



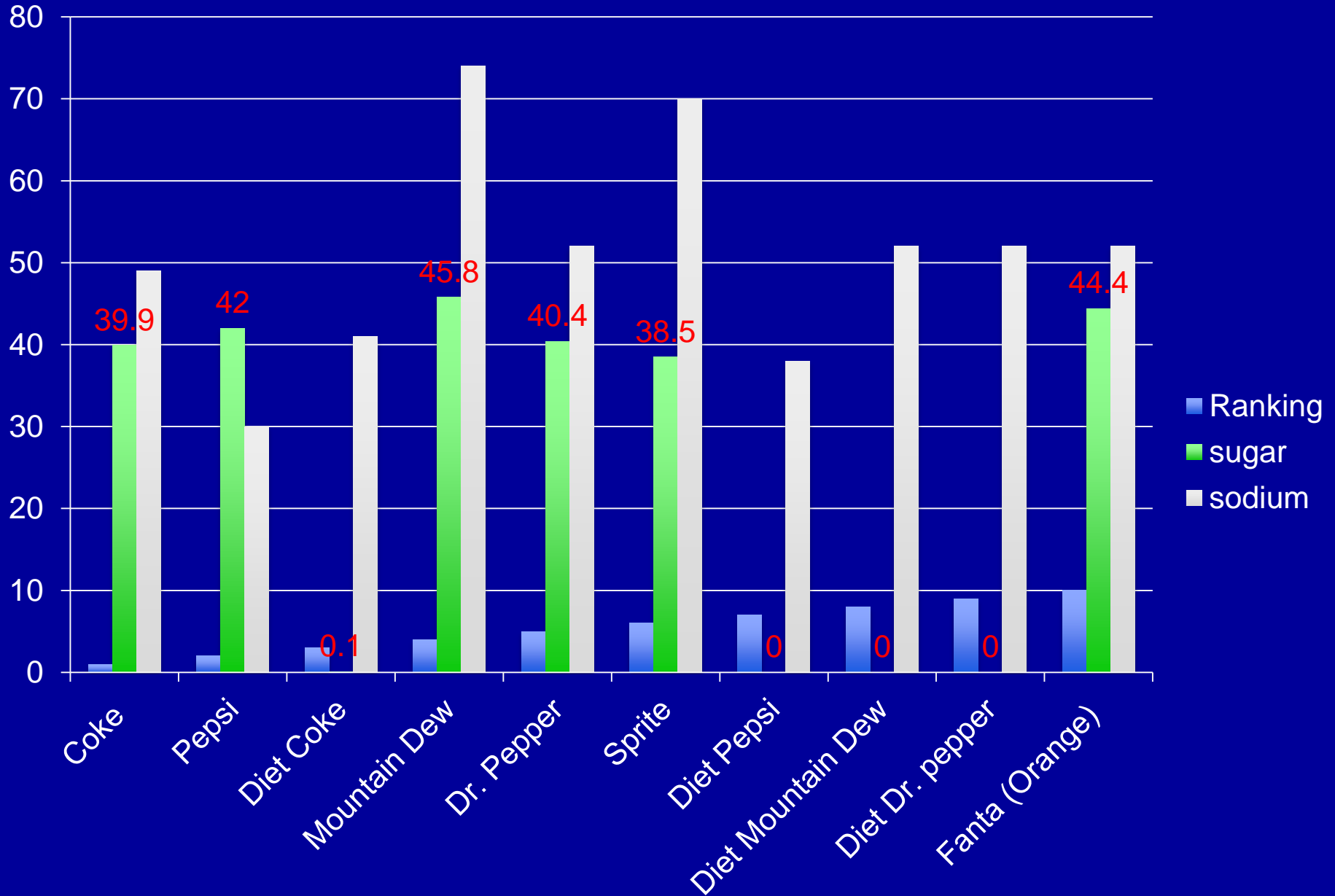
# Preference vs. Fat Content for Potato Chips



# Beverage Market Share vs. Calories



# Beverage Market Share vs. Sugar and Sodium Content



# Key Points

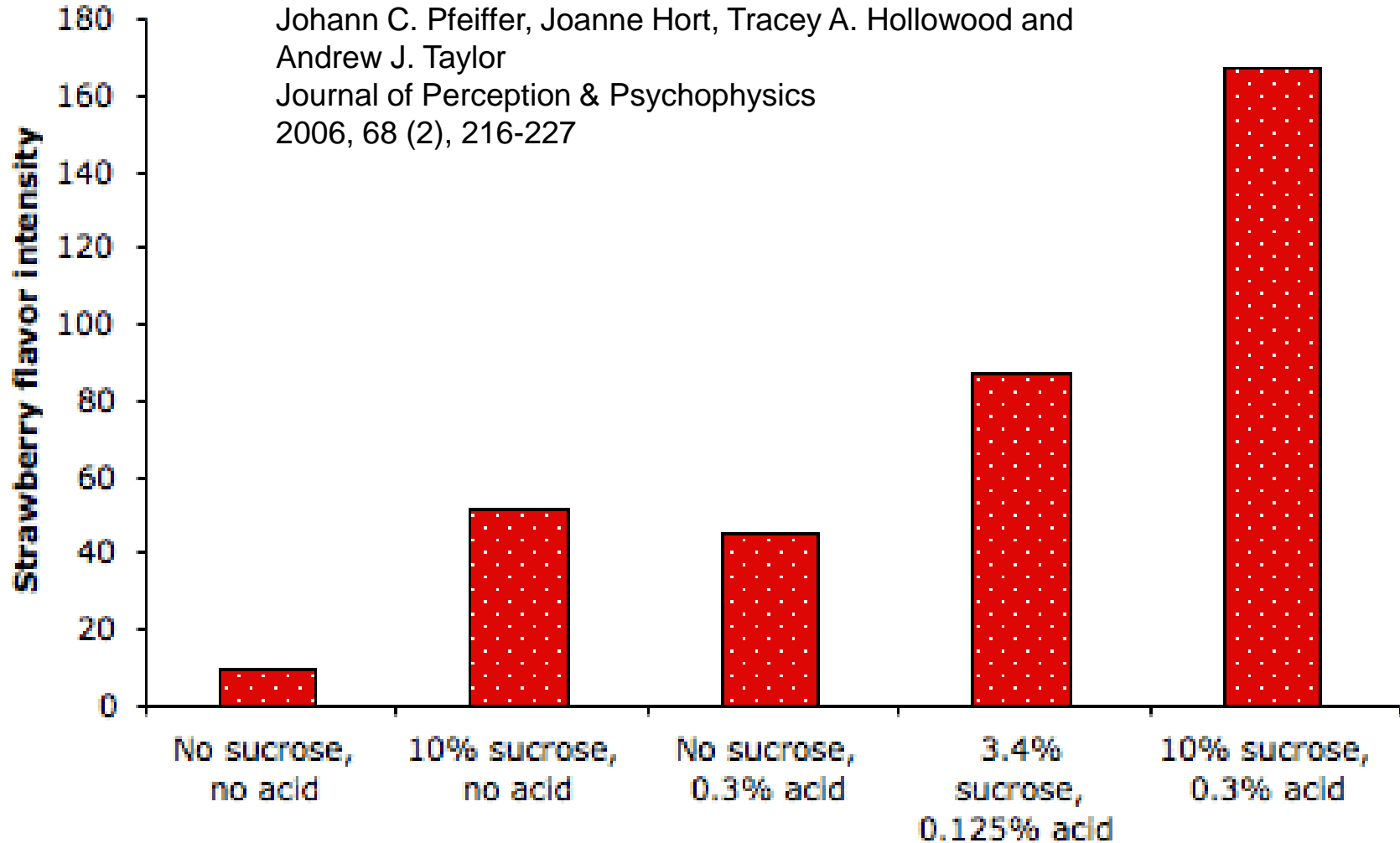
- Preference based on “total” liking not level of sugar / salt etc.
- Possible to formulate “healthier” products
- Products formulated to specific markets

# Interactions – Magic for Products

- It's not the level of salt, sugar, fiber, whole grain, fat, etc., that drive overall liking!
- It's the total relationship of those in some optimal mixture
- Materials like fiber and whole grain may be “sodium sparing” but we'd never know using conventional methods



Taste-aroma interactions in a ternary system: A model of fruitiness perception in sucrose/acid solutions  
Johann C. Pfeiffer, Joanne Hort, Tracey A. Hollowood and Andrew J. Taylor  
Journal of Perception & Psychophysics  
2006, 68 (2), 216-227



Interactions of Strawberry Flavor with Sugar and Acid Levels – Strawberry Flavor Constant



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# A Modeling Approach

*Your opinion is not in the  
recipe.*



# Product Development – Optimized

- “Optimal” Product Development is achievable
  - Optimal means your product can be developed so:
    - Health maximized
    - Consumer acceptance maximized
    - Cost minimized
  - All simultaneously

# A Process

- DOE or Design of Experiments
  - Statistical Experimental Design
- Techniques developed in late 1800's and refined in the 1940's
- Applied in pharmaceutical, aerospace, chemical, engineering, food, marketing, etc.. for complex problems

# A better way of experimentation ...

- Faster
- Cheaper
- Superior Results
- Backed by Data

## New Outcomes Possible

- Optimal Formulas
- Optimal Processing
- Reduced Development Times
- Knowledge of System

# How does it work?

- Ingredients / process variables may be standard or experimental
- For potato chips – maybe:
  - Salt Level
  - Oil Temperature
  - Frying Time
  - Flavor / Seasoning Level



# The Experiment

- We “design” an experiment that would bracket and go “beyond” the typical ranges and use levels of ingredients and process variables
- ~ 24 experiments + competitive samples if appropriate

# The Responses

- Data are collected on these samples (for example)
  - Liking
  - Salt Impact
  - Texture
  - Off Flavor
  - Formula cost
  - As many “responses” as you wish may be collected

# The Result

- A mathematical model is generated to model and predict all the changes made to the system
- Because we know ingredient costs and sodium levels, they can be part of the model

## We now can find...

- For example:
  - Best liked product
  - Best liked product at lowest cost
  - Best liked product at lowest sodium level
  - Best liked product at lowest sodium level AND lowest cost

## We also can answer:

- In going from the highest to lowest level of added salt – exactly where does liking drop off?
- What are the optimal frying temperatures and times?
- Are there interactions between spice level and salt?
- How does frying time affect texture?

# The Payoff

- You could do hundreds of “trial & error” experiments and not have this type of information.

# Process Recap

Identify  
Factors



Select  
Responses



Prepare  
Experimental  
Products



Gather Data



Model  
Responses

# Health Driven Example

- How far can we move “healthy” ingredients and still have a well liked product?



# New “Healthier” Bread

- Factors: (as an example)
  - Insoluble Fiber Added
  - Soluble Fiber Added
  - Added Salt
  - Added Oil
  - Water Level

# Responses

- Liking
- Loaf Volume
- Texture Measurements
- Off Flavor

# Outputs

- The formula with the highest overall liking.
- The formula with the highest overall liking, highest fiber, lowest sodium and lowest cost simultaneously!
- Best liked ratio of soluble /insoluble fiber.

# Finding the Limits

- Importantly, the model can be used like this:
  - Find me the “best liked” formula with the following constraints:
    - 300 mg. sodium / serving
    - 6 g fiber / serving
    - 1 % oil
  - Or – optimize to 60 calories / slice ,etc..

# Responses

- Data guiding the model can come from in-house tasters, expert panels, or directly from consumers
- The model, of course, is best guided by your consumers

# Optimization

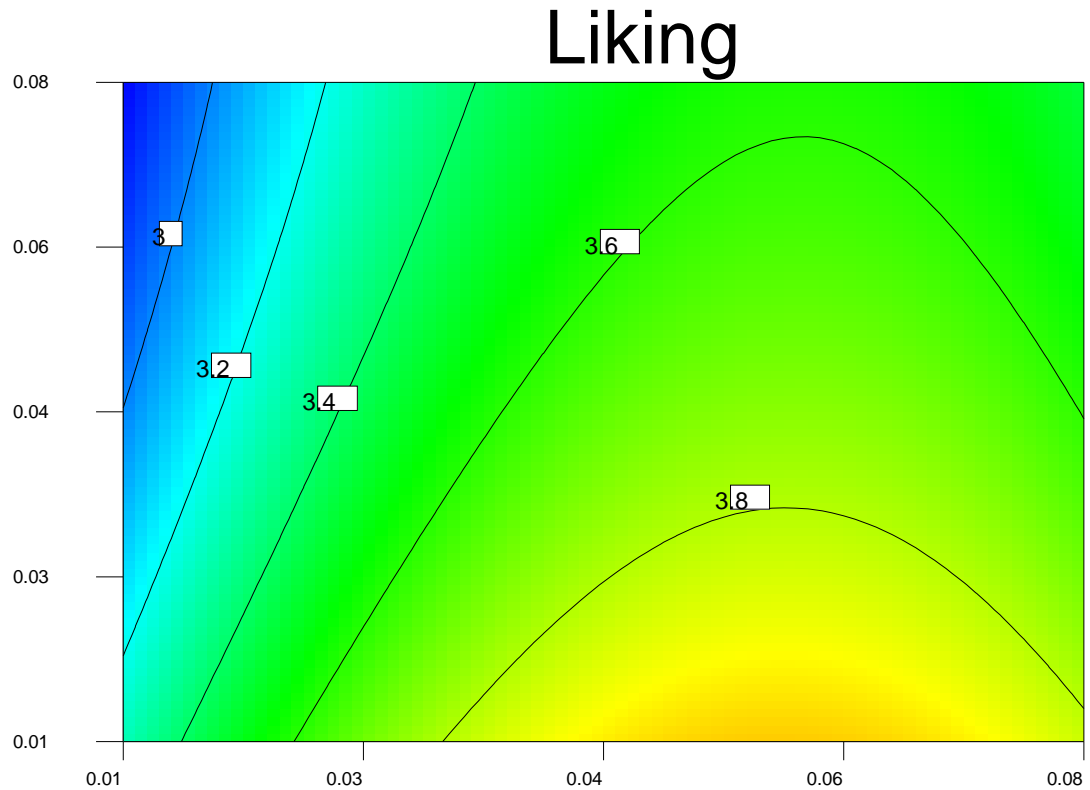
- The “output” of the method is a formula:  $x$  % fiber,  $y$  % salt, etc.. to meet constraints
- Graphs allow you to actually visualize the relationships factors have to responses!

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Software  
Factor Coding: Actual  
Liking  
4.28  
2.8

A: Fiber



B: Added Salt

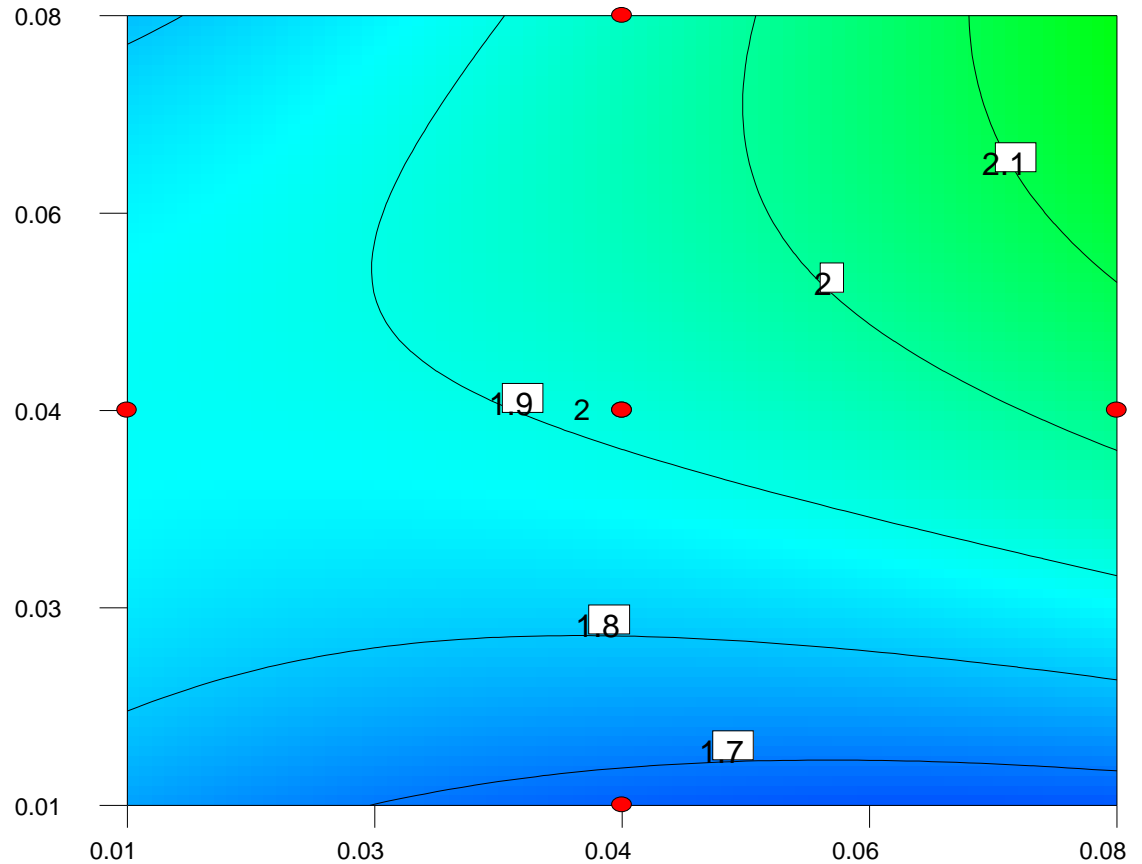
# Fields of Gold Consulting LLC

Optimized Food, Process and Flavor Development

Software  
Factor Coding: Actual  
Off Flavors  
• Design Points  
2.85  
1.54

Fiber Content

## Off Flavors



Whole Grain Content

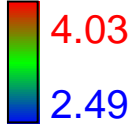


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Software

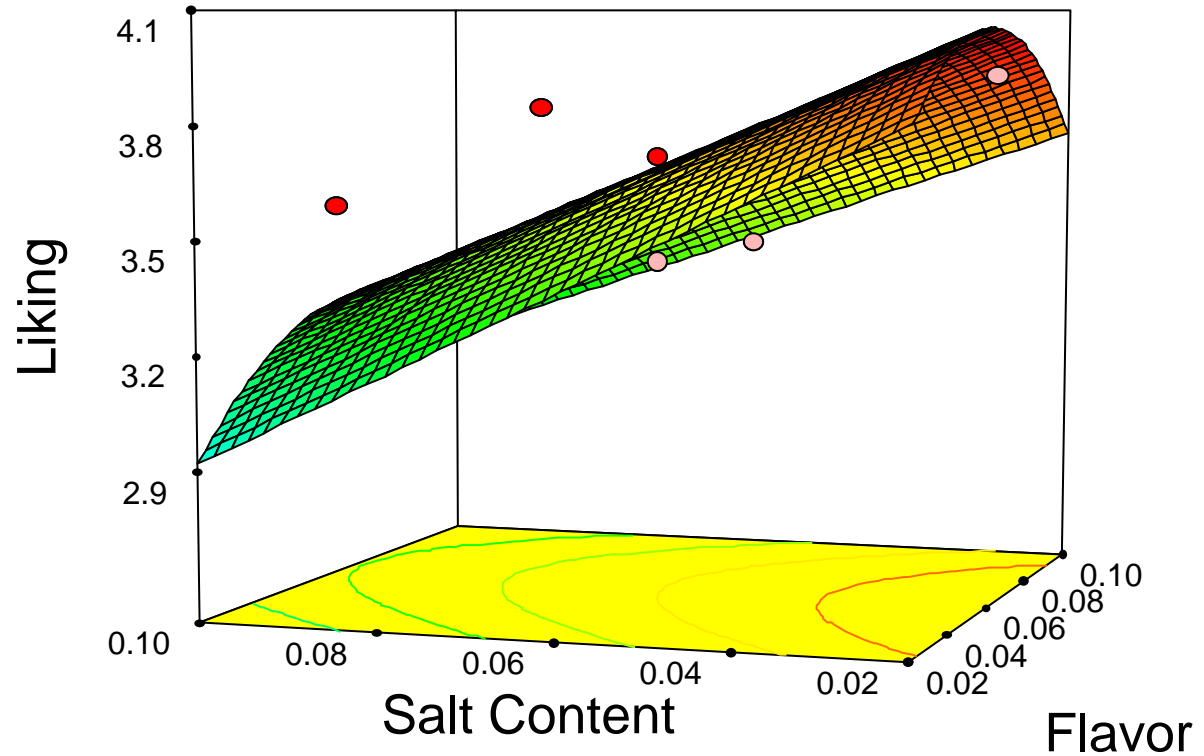
Liking



Actual Factors

C: Factor = 0.07

D: Factor = 0.03



## Conclusions

- There is opportunity for healthier products
- We haven't found it because we haven't looked
- There are proven techniques to assist you in your development

## Conclusions

- Food development problems such as this are too complex to understand fully without advanced methods
- We'd be glad to discuss your development challenges

## Some Predictions...

- Beverages become an increasing delivery system for fiber
- Whole grain consumption goes up
- Increased application of stevia sweetened products
- Lower caloric density products via fiber
- Increased use of legumes in all foods



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Questions?

➤ Thank you!