Tuna Apple Crisp

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What is a Prickly Pear Fruit?

- A cactus plant native to the Western Hemisphere
- The fruit is commonly referred to as tunas
- Comes in different colors; red, wine-red, green, and yellow
- A spiky, rounded fruit that must be peeled and de-seeded

Abstract

- We investigated whether a Tuna Apple Crisp recipe could be modified to be made healthier and still meet the acceptability of the general public.
- We used two different variables to make our recipe healthier.

The different treatments:

1. Regular recipe (white flour and sugar)
2. Modified recipe (white flour and Splenda)
3. Modified recipe (wheat flour and sugar)
4. Modified recipe (wheat flour and Splenda)

Abstract

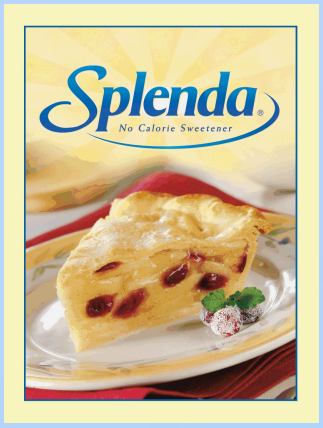
Reasons why we chose these different treatment options

- To help increase fiber in a desert
- To reduce the number of calories consumed from sugar

Objective

- To determine if healthy modifications can be made to the Tuna Apple Crisp without compromising taste, texture, and overall visual appearance.

OR



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Why we chose the Prickly Pear Cactus Fruit

- Only 16 out of 133 people surveyed had tasted the prickly pear cactus fruit.
- Want to educate the public on how to prepare this fruit.
- Want to educate the public on the health benefits of the prickly pear cactus fruit.

Literature Review

- Cactus Pear Fruit: A new source for a natural sweetener
  - Sweetness of the fruit is similar to the sweetness of a glucose syrup and is lower in sweetness than fructose.
  - When used in recipes, less sugar can be used because of the naturally sweet syrup of the fruit.

Literature Review

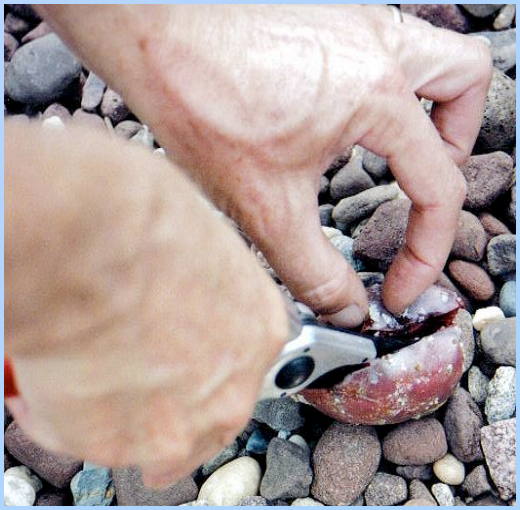
- Consumer Perception and Choice of Minimally Processed Vegetables and Packaged Fruits
  - Consumers buy processed vegetables because it is convenient and fast.
  - Health and nutrition was not of high importance for the consumers surveyed.
  - Freshness and taste were a factor that consumers considered when buying products.

Literature Review

- Prickly Pear Cactus
  - Discussed the health benefits of the prickly pear.
  - Rich source of flavonoids, plant pigments, and antioxidants.
  - The pods are also high in vitamin C, beta carotene, and fiber.

Literature Review

- How to Cut and Prepare a Prickly Pear
  - Describes the process of preparing a prickly pear cactus fruit.
  - A very time consuming process.
  - Steps:
    - Remove thorns while wearing heavy duty gloves
    - Blanch the fruit for 1 minute
    - Remove the skin
    - Remove all of the seeds in the middle



Literature Review

- Baking with Sugar Substitutes
  - Gives advice on how to substitute sugar with artificial sweeteners.
  - Some sweeteners are not meant to be used for baking, but Splenda is one of the few that works.

Materials & Methods

Independent Variables

- White Flour
- Wheat Flour
- White sugar
- Splenda

Dependent Variables

- Texture
- Sweetness
- Consumer acceptance

Characteristics

Control Tests	Wheat flour/Splenda		White flour/White Sugar	
	Mean	Standard Deviation	Mean	Standard Deviation
AROMA-Spice	5.75	1.83	6.25	1.91
Sweet	5.13	2.1	6.0	1.69
FLAVOR-Sweet	6.63	0.92	7.63	0.97
Nutty	5.75	1.67	5.88	0.99
Fruity	5.63	2.13	6.13	1.25
TEXTURE-Crispy	6.25	2.12	3.63	2.0
Firm	5.0	2.39	2.75	1.04
Crumbly	6.5	0.76	3.38	2.39

Nutrition Facts

	White flour and Sugar	Wheat flour and Sugar	White flour and Splenda	Wheat flour and Splenda
Kcals	426.5	414.92	345.03	333.44
Protein	3.72	3.91	3.72	3.91
Carbhydrates	66.51	64.58	45.51	43.58
Fat	17.96	18.075	17.96	18.075
Fiber	4.6	6.79	4.6	6.79

Rationale for selected objective & sensory methods

- Objective Methods
  - Penetrometer
    - To ensure the treatments didn't vary in firmness
- Sensory Methods
  - QDA
    - Qualities that influenced the outcome of our treatments

Procedures

- To ensure uniform sample…
  - Each member performed the same tasks each week, using the same procedures

- The same ingredients, ovens, pans, & cooking time were used each week in the same environment

Execute Experiments Using Objective Methods

- Penetrometer
  - Measuring out equal sample sizes
  - Letting Tuna Apple Crisp cool before testing
  - Cleaned penetrometer after each use
  - Accurate time measurements
  - Repeated 3 times, took average number
  - Accurate readings of scale

Using Objective & Sensory Methods

- Sensory Methods
  - Conducted panelist trainings
  - Took place in red room
  - Panelist randomly tasted treatments
  - Cleaned palette with water in between tastings
- Objective Methods
  - Practiced with other foods before
  - Each member had a specific task
  - Used equal amounts in each trial

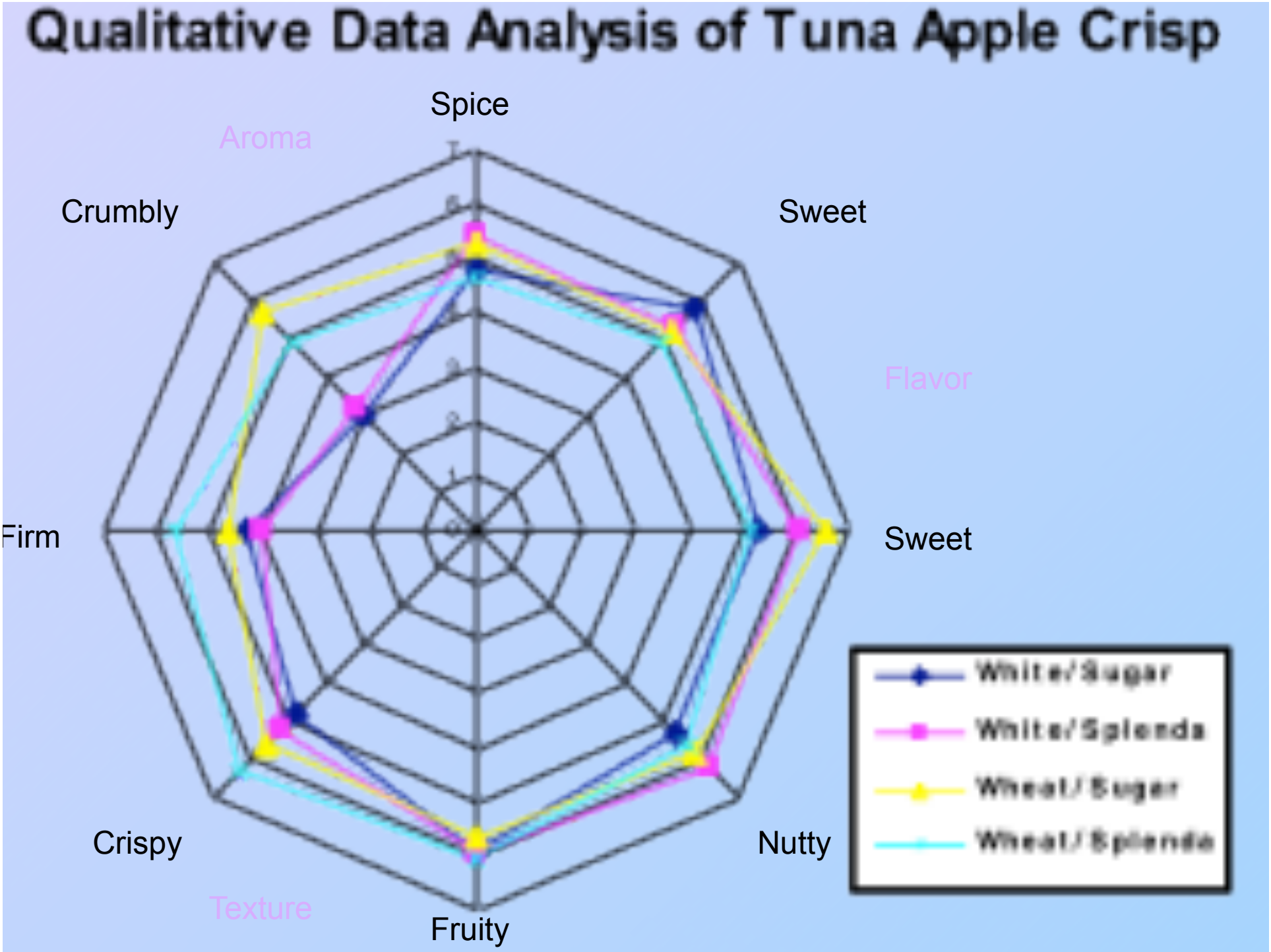
Results and Discussion

Table 1. Qualitative Data Analysis for Tuna Apple Crisp

CONTROL TESTS	White/Sugar		White/Splenda		Wheat/Sugar		Wheat/Splenda	
	MEAN	SD	MEAN	SD	Mean	SD	Mean	SD
AROMA-Spice	4.75	1.91	5.38	1.85	5.25	1.75	4.63	2.56
Sweet	5.75	1.58	5.25	1.75	5.13	1.81	4.88	1.87
FLAVOR-Sweet	5.25	1.49	6	1.69	6.5	1.2	5.13	1.36
Nutty	5.25	1.83	6.1	1.36	5.75	1.75	5.5	1.51
Fruity	5.88	1.55	5.88	1.36	5.63	1.3	6	1.31
TEXTURE-Crispy	4.75	1.83	5.1	1.96	5.5	1.41	6.25	1.28
Firm	4.25	1.75	4	1.6	4.63	1.92	5.63	1.3
Crumbly	3	1.31	3.13	1.36	5.62	1.6	4.88	2.1

Figure 1.

Qualitative Data Analysis of Tuna Apple Crisp



Results of Qualitative Data Analysis for Tuna Apple Crisp, Figure 1.

- Evaluated aroma, flavor and texture characteristics
- 1 = Characteristic not present
- 8 = Characteristic very present

Results

- Wheat flour and sugar was sweetest and most crumbly
- Wheat flour and Splenda was least sweet
- Wheat flour and Splenda was most crisp and firm
- White flour and sugar was least firm and crumbly
- White flour and Splenda was least firm

Firmness of Tuna Apple Crisp using Penetrometer Cone Test

Treatments	Mean and Standard Deviation
White Flour/ White Sugar	**41 ± 14.8**
White Flour/ Splenda	**70 ± 6**
Whole Wheat Flour/ White Sugar	**63 ± 33.2**
Whole Wheat Flour/ Splenda	**54 ± 25.6**

Figure 2.

Results of Penetrometer test on Tuna Apple Crisp, Figure 2

- Wheat flour and white sugar most firm, 63 ± 33.2
- Second most firm, wheat flour and Splenda 54 ± 25.6
- **Wheat flour creates a firmer product**
- Third most firm, white flour and white sugar, 41 ± 14.8
- Lastly, the white flour and Splenda least firm, 70 ± 6
- **White sugar creates a firmer product**

9 Point Hedonic Scale for Tuna Apple Crisp

	Mean	Standard Deviation
White Flour and Sugar (Control) T1	6.92	2.89
White Flour and Splenda T2	7.4	2
Wheat Flour and Sugar T3	6.36	5.3
Wheat Flour and Splenda T4	7.06	3.4

Figure 3.

Results of 9-point Hedonic Scale for Tuna Apple Crisp, Figure 3

- 9-point hedonic scale on four treatments
- Measured acceptability of Tuna Apple Crisp from 50 panelists
- 1 = disliked extremely, 9 = liked extremely
- Results
- White flour and Splenda, highest acceptability
- Next, wheat flour and Splenda
- Third, white flour and sugar
- Least acceptability, wheat flour and sugar
- **Consumers prefer the taste of Splenda**

What our data indicates

- QDA:
  - Sweetness, crispness, firmness and sweetness varied throughout the 4 treatments
    - Wheat flour/Splenda = least sweet, most firm and crisp
- Objective methods results: penetrometer
  - Wheat flour/white sugar = most firm
  - Wheat flour/Splenda = second most firm
  - White flour/Splenda = least firm
- Only <u>one</u> significant difference found between our treatments (Hedonic Scale)

— Treatment 2: White Flour/Splenda

— Treatment 3: Wheat Flour/Sugar

Data compared to hypothesis

- Our hypothesis:
  - Healthy modifications can be made to the recipe without compromising taste, texture and overall appeal
- Data
  - Our data is consistent with our hypothesis in that the changes we made to the original recipe proved to be positive changes in terms of taste and texture

Why was a difference seen between the two treatments?

A British study on Sucralose (Splenda) vs. Sucrose

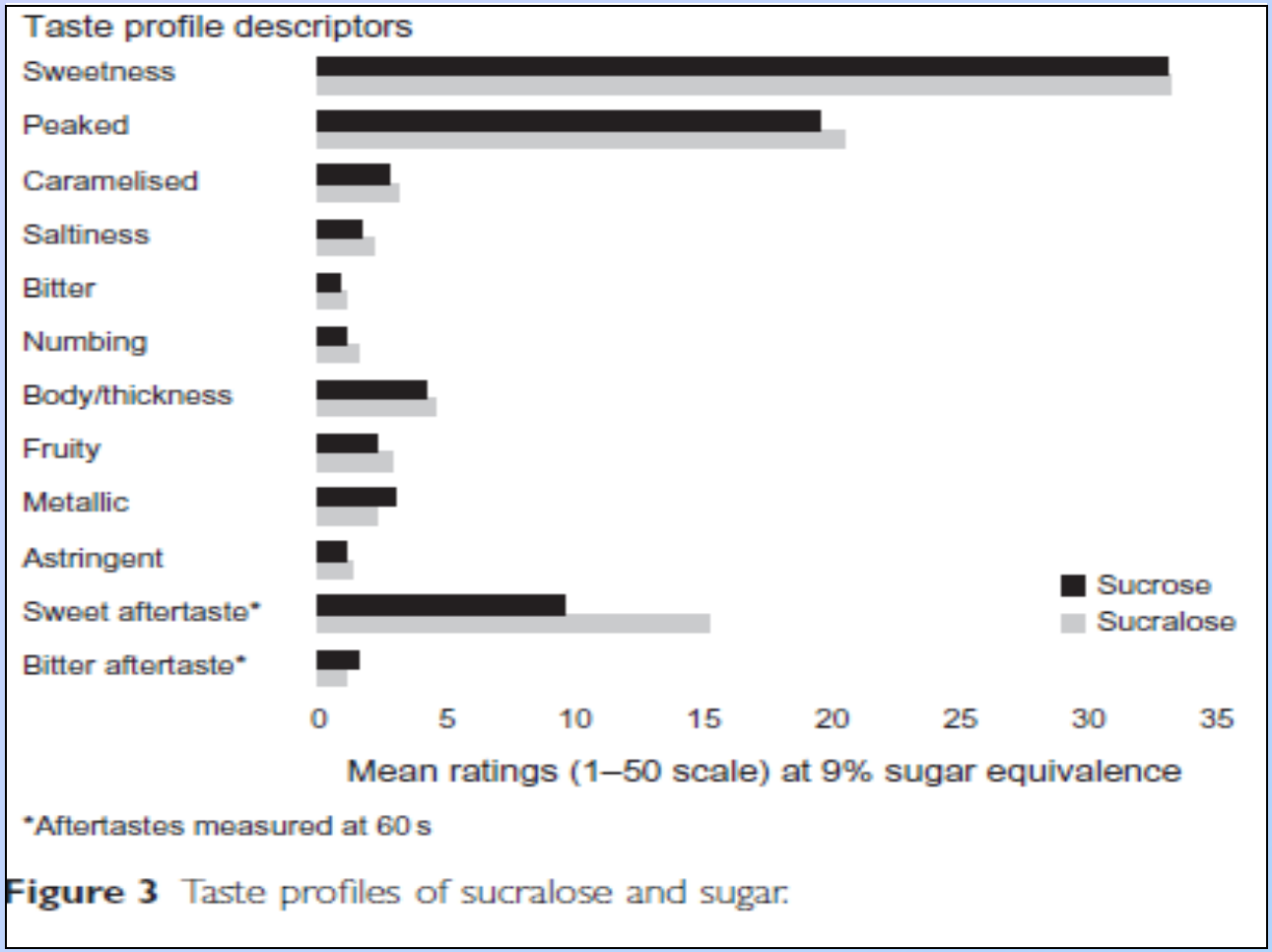


Figure 3 Taste profiles of sucralose and sugar.

Sucralose – all sweetness and light
British Nutrition Foundation *Nutrition Bulletin,* 2003

The British study, cont.

- Sucralose (Splenda)is:

– Approx. 600 times sweeter than sucrose (depends on the concentration)

– Sweetness can be influenced by pH, temp and gelling agents, starches and fats

– Resistant to enzymes – energy-free

– Does not interact with other ingredients in food

– Stable during high-temperature processing (baking)

❖The sweetness of the Splenda may have been influenced by other ingredients which may account for it not being considered as sweet

Two studies on Whole Wheat Flour

- Study #1: Whole Wheat Flour (WWF) vs. Commercial White Flour (CWF)
  - Main Findings from this study:
    - The quality of bread was improved when WWF was substituted for CWF
    - WWF can be used for bread-making to improve nutritious quality of bread for health benefits

Table 1
General composition analysis of whole waxy wheat and commercial flours[a]

Main constituents (wt%, db)	Sample	
	Whole waxy flour	Commercial flour
Moisture	10.4 ± 0.3	13.4 ± 0.1
Protein	13.5 ± 0.3	12.6 ± 0.1
Total carbohydrate	58.4 ± 0.2	68.8 ± 0.2
Lipid	0.8 ± 0.1	1.5 ± 0.1
Ash	1.6 ± 0.1	0.3 ± 0.1
Dietary fiber	15.3 ± 0.2	3.4 ± 0.1
Soluble	4.1 ± 0.2	1.8 ± 0.1
Insoluble	11.2 ± 0.2	1.6 ± 0.1
Ferulic acid (μg/g)	1154 ± 106	81.0 ± 20

[a] The value shows the mean of at least duplicate data.

WWF:

- Firmness of bread crumbs made with 30% and 50% WWF increased after 3 days storage

- Specific volume of WWF was lower because of the high amount of dietary fiber

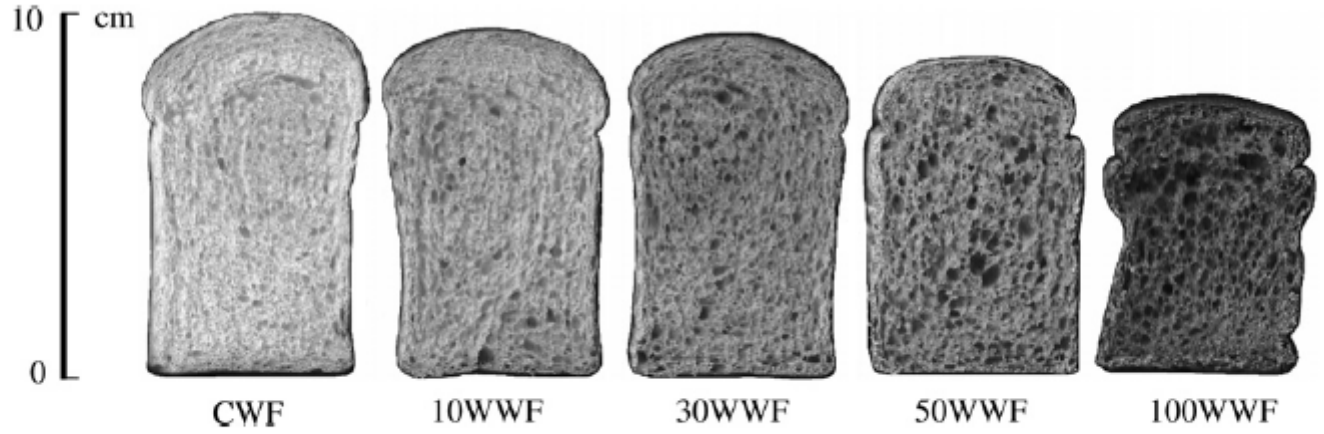


Fig. 2. Cross-sectional views of breadcrumbs made from whole waxy wheat flour (WWF) and its substitutions. Abbreviations are the same as in Table 2.

- Study #2: Organic roller-milled wheat vs. stone-milled wheat

- Main findings from study #2:

  Whole meal breads of roller-milled wheat were dominated by **sweetness, juiciness and compactness attributes**, whereas those from stone-milled wheat were characterized by saltiness, deformity and roasted cereal attributes.

  ❖These positive attributes of whole wheat flour may have contributed to there being a difference between the White flour/Splenda treatment and the Whole Wheat flour/Sugar treatment

Similarities and Differences

- Similarities:
  - In both cases the product made form whole wheat flour was more firm and crisp than the white flour counterpart
- Differences:
  - The British study claimed that Splenda was approx. 600x sweeter than regular sugar
  - Our results, however, showed the opposite. This may have been due to the pH of our recipes or interactions with other ingredients

Limitations

- Panelists were not properly trained
- Relatively small sample size, n=50
- Penetrometer measurements may be inaccurate
- Some vagueness with QDA

Conclusion

- Quantitative descriptive analysis (QDA)
  - Wheat flour/white sugar = sweetest
  - Wheat flour/splenda = most crispy, firm, and crumbly
- 9-Point Hedonic Scale (Sensory evaluation)
  - Trained panelist (class)
  - Un-trained panelists (50 people on Chico State Campus)
  - Results were the same
  - Ratings on consumer acceptance

1. White flour/ splenda (highest rating)
2. Wheat flour/ splenda
3. White flour/ sugar
4. Wheat flour/ sugar (lowest rating)

Conclusion

- Penetrometer Cone test
  - The two tests taken had different results
  - Could be due to error in performing the test
  - The second test seems more accurate than the first

1. Wheat flour/ white sugar (most firm)
2. Wheat flour/ splenda
3. White flour/ white sugar
4. White flour/ splenda (least firm)

Bottom Line

- Wheat flour/ white sugar = sweetest
- White flour/ splenda = highest consumer acceptance ratings
- According to QDA wheat flour/splenda was most crispy, firm, and crumbly
- According to Penetrometer Cone test wheat flour/ white sugar was most firm

Recommendations

- More research needs to be done on the different effects of splenda and white sugar on the texture of crisps
- The sensory evaluation on consumer acceptance needs to be done:
  - Bigger sample size
  - Broader sample size
  - Panelists that are trained in sensory evaluation

If We Could Do It Again

- We would be more accurate in using the penetrometer cone test to measure the firmness of the crisps:
  - Cut each piece of the crust to the same measurement
  - Let the crisps cool before doing the test
  - Use both the flat and pointed probe on the penetrometer
- We would use the same amount of prickly pear cactus each time we make the crisps
  - This would make the results from the tests and evaluation more accurate

References

- Binns N. Sucralose – all sweetness and light. British Nutrition Foundation *Nutrition Bulletin*. 2003;28:53–58.
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