HONEY IN HEAT-PROCESSED AND FRESH SALSAS

Key findings of a research project conducted for the National Honey Board at the Department of Foods and Nutrition, Kansas State University, Manhattan, Kansas.
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Background

Salsa is the leading U.S. condiment.[1] Honey is used widely in many condiments including mustards, barbecue sauces and dressings, yet only occasionally in salsa. However, a sweetened-salsa market is developing as some manufacturers have begun taking salsas beyond their tomato/spice roots.

Project objective

The objectives of this National Honey Board- sponsored research project were to:

1. study the desirability and feasibility of the addition of honey to heat-processed and fresh salsas,
2. determine optimum levels of honey, capsaicin (the naturally-occurring heat compound in hot peppers) and acidity in salsa,
3. test various optimized formulas with consumers,
4. understand the interactive effects of honey, heat and acidity on flavor and texture and
5. determine the shelf-life stability of salsa with added honey.

Experimental design

Part 1: Formula development

A response surface central composite design with three independent variables (five levels of honey, pH and heat) was used to develop 18 formula variations of salsa. The test design produced 14 products, three additional "central" products and a control with no added honey. Heat-processed and fresh salsa formulas were developed from commercially available products. Heat-processed salsa contained canned products, with the exception of fresh cilantro and frozen diced onions, and was cooked and canned. Fresh salsa was made with fresh ingredients and was not cooked. For both types of salsa, capsaicin was diluted and used to obtain varying levels of heat (burn intensity).

Part 2: Descriptive sensory analysis

Highly trained and experienced panelists from The Sensory Analysis Center at Kansas State University evaluated 18 samples of heat-processed and fresh salsas. Data provided by the panel was analyzed using Response Surface Methodology. Graphs generated from this method were used to determine salsa formulas with optimum levels of heat, acidity and honey. Three heat-processed and three fresh salsa formulas, containing 0, 5 and 10 percent honey respectively and a stabilized pH of 3.8$\pm$ 0.1 were developed. Heat-processed salsa contained 3.5 ppm capsaicin and fresh salsa contained 2.8 ppm capsaicin. Lower concentrations of capsaicin were used in fresh salsa because preliminary data showed that capsaicin produced higher burn intensities in fresh salsa. The six optimized formulas were used for consumer testing.

Part 3: Consumer evaluation

One hundred and four consumers between the ages of 18 and 65 evaluated the six optimized formulas containing 0, 5 and 10 percent honey respectively. A nine-point hedonic (liking) scale was used for evaluation. Plain tortilla chips were provided for testing.

Part 4: Shelf-life studies

Heat-processed salsa was analyzed for moisture, water activity (a_w), pH, percent sugar

(Brix) and microbial activity after 30 days in an accelerated incubator at 50 percent relative humidity and 33^{0}C. Fresh salsa was analyzed for moisture, water activity, pH, Brix and microbial activity following 16 and 45 days of storage at 57 percent relative humidity and 4.9^{0}C.

Results and discussion

Descriptive sensory analysis

Trained panelists evaluated 18formula variations of fresh and heat-processed salsas for sweetness, honey flavor, sour response, burn intensity (heat), textural viscosity and crispness.

Sweetness: Sweetness increased with increasing honey content in both types of salsas and slightly decreased with increasing acidity.

Honey flavor: As expected, honey flavor increased with increasing honey levels but was slightly decreased by pH in both types of salsas. However, pH affected fresh salsa at higher levels of honey.

Sour response: Honey has a buffering effect on sourness. In heat-processed salsa, the sour response greatly increased with increasing acidity at low honey levels. However, increasing levels of honey decreased the sourness response despite increasing acidity.
In fresh salsa, increasing acidity had no effect on the sourness response at low honey levels. However, similar to heat-processed salsa, increasing honey levels decreased the sourness response.

Burn intensity (heat): In heat-processed salsa, burn intensities were affected only by capsaicin concentration. Honey had no effect.

Textural viscosity: In heat-processed salsa, honey significantly decreased textural viscosity. Honey is hygroscopic (water extracting) and therefore causes a decrease in viscosity. However, in fresh salsa, reliable data could not be collected due to the extremely chunky nature of the product.

Crispness: Crispness of both salsa types was increased by honey and acidity. In both heat-processed and fresh salsas, increasing pH increased the crispness response in salsas containing higher honey levels. Firmness in fresh salsa was only affected by honey level, especially at moderate levels.

Table 1: **Consumer responses for overall liking and flavor intensities**
(Scores based on a nine-point semi-anchored hedonic scale).

Honey Level (%) & Heat	Overall* †	Blendedness †	Heat †	Sweet ** †	Sour ** †	Tomato * †
0 Fresh	3.8	3.2	4.3^a	2.6^a	3.5	4.7
0 Process	5.3	5.3	5.7^b	3.0^{bc}	3.0	5.4
5 Fresh	4.0	4.0	4.5^{bc}	4.6^c	3.0	5.0
5 Process	4.9	4.9	5.2^{cd}	5.8^d	2.4	5.4
10 Fresh	3.7	3.7	5.5^d	6.2^e	2.7	4.7
10 Process	4.6	4.6	4.9^d	7.2^e	2.3	4.9

*Honey levels significant at $p<0.10$
**Honey level significant at $p<0.05$
†Process significant at $p<0.05$

Sweetness: Sweetness increased with increasing honey content in both types of salsas and slightly decreased with increasing acidity.

Honey flavor: As expected, honey flavor increased with increasing honey levels but was slightly decreased by pH in both types of salsas. However, pH affected fresh salsa at higher levels of honey.

Sour response: Honey has a buffering effect on sourness. In heat-processed salsa, the sour response greatly increased with increasing acidity at low honey levels. However, increasing levels of honey decreased the sourness response despite increasing acidity.
In fresh salsa, increasing acidity had no effect on the sourness response at low honey levels. However, similar to heat-processed salsa, increasing honey levels decreased the sourness response.

Burn intensity (heat): In fresh salsa, higher levels of honey reduced burn intensity five seconds into the aftertaste. Burn intensities at one, three and seven minutes were also reduced in fresh salsas containing higher levels of honey and capsaicin.

Consumer evaluation

Consumers evaluated heat-processed and fresh salsas for burn intensity, sweetness, tomato flavor, sourness,

blendedness and overall acceptability.

Burn intensity: Honey had no affect on consumers' perception of heat for fresh or heat-processed salsas ($p<0.05$).

Sweetness: Increasing honey levels in heat-processed and fresh salsas increased the sweetness response ($p<0.001$).
Processed salsa received consistently higher scores for sweetness than fresh salsa. This can be expected because tomatoes that are heat-processed produce sweet aromatics and flavors from the carmelization of the tomatoes' natural sugars.[2]

Sour response: Sourness was significantly affected by honey and processing ($p<0.001$). In both heat-processed and fresh salsas, sourness decreased with increasing honey level. Because the pH of both salsa types was 3.8± 0.1, it could not be a factor in these differences.

Tomato flavor: Tomato flavor of fresh salsa was significantly affected by honey level ($p<0.10$) and processing type ($p<0.001$). Fresh salsa ranked significantlylower in tomato flavor than heat-processed salsa. However, this may be because consumers are exposed more frequently to heat-processed tomato products than fresh tomato products.[3] Fresh tomatoes have a less concentrated flavor due to lack of processing. Both heat-processed and fresh salsas containing five percent honey received the highest scores for tomato flavor.

Blendedness: Consumers gave fresh salsa a lower score for blendedness than processed salsa. Fresh salsa had distinct vegetable particles suspended in a moderate amount of clear juice; whereas the heat-processed salsa had a consistent texture. Therefore, it is not surprising that the fresh salsa received lower scores. Apparently consumers thought blendedness described the degree to which vegetables where mixed together rather than a flavor attribute.

Overall acceptability: Because consumers have more experience with unsweetened salsa, overall acceptability for both salsa types averaged less than six on the nine-point hedonic scale. Fresh salsa received significantly lower scores than heat-processed salsa possibly because consumers are more familiar with heat processed salsas. Although the liking for both salsas decreased as the honey content increased ($p<0.10$), a number of consumers liked salsa which contained higher levels of honey. Forty-four percent of consumers liked five percent fresh honey salsa more than salsa without honey. Fourteen percent and 12 percent of consumers rated five percent and 10 percent fresh honey salsa in the top three boxes of the nine-point hedonic scale. Similar results appeared in heat-processed salsa. Thirty-one percent of consumers liked five percent heat-processed honey salsa more than 0 percent; 29 percent liked 10 percent heat-processed honey salsa more than 0 percent.

Shelf-life studies

Heat-processed and fresh salsas were tested for viscosity, color, water activity (a_w), pH, moisture, Brix and bacteria, mold or yeast contamination.

Heat-processed salsa: There were significant decreases ($p<0.05$) in moisture and increases in Brix (percent sugar) levels with increasing honey levels in processed salsa. The addition of honey increased the mass in the salsa, without increasing moisture significantly, thus decreasing the overall moisture content at higher honey levels. Water activity and pH were not affected by honey level at day zero ($p>0.05$). After 30 days, moisture increased slightly at all honey levels. However, Brix, a_w and pH did not change. These results were expected due to the stable nature of the canned atmosphere where the hermetic seal in the can prevents moisture loss. Because of processing, acidulation and the addition of potassium sorbate, no microbial counts appeared at day zero or after 30 days of accelerated incubation.

Fresh salsa: Initially, in fresh salsa a_w, moisture and Brix changed significantly with honey level. Honey is a humectant (binds free water) and therefore lowers a_w. Moisture significantly decreased ($p<0.001$) as honey

level increased due to the low moisture of honey, its addition to salsa increases mass without adding significant amounts of moisture, thus decreasing the overall moisture content of the salsa at increasing honey levels.

Significant differences among treatments over time did not occur until day 45. Moisture showed a slight, yet significant reduction ($P<o.o5$). Moisture loss may be attributed to heterogeneous sampling of a chunky product since the salsa had been stored in high density polyethylene containers which prevent moisture loss.

Over time, Brix increased and a_w and pH decreased significantly ($p<0.05$). The change in a_w can be attributed to the expulsion of water from vegetable tissues caused by the presence of honey. Though lowering the a_w is important in preserving shelf-life, the final a_w was at a relatively high level (0.85).

Microbial growth appeared on six of 18 test plates at day zero. This was to be expected due to the use of fresh ingredients. Microbial counts showed no growth after 16 and 45 days which was expected due to the use of potassium sorbate in conjunction with citric acid, low pH and refrigerated storage. For viscosity and color to be analyzed, a product must be uniform throughout. Therefore, due to the chunky and colorful nature of salsa, unreliable results were obtained for viscosity and color.

Conclusion

Forty-four percent of consumers preferred fresh salsa containing five percent honey over salsa with no honey. Thirty-one percent preferred heat-processed salsa containing five percent honey and 29 percent preferred processed salsa containing 10 percent honey. These preferences, although favorable, were likely lower because consumers have more experience with unsweetened salsas. However, this research indicates that a potential market exists for consumers who are willing to try sweeter-tasting salsas. Further analysis revealed that:

- Honey had little effect on perception of burn in heat-processed salsa.
- Increasing honey level increased honey flavor and crispness.
- Heat-processed salsa was rated higher in overall acceptability than fresh salsa by consumer analysts.
- Increasing honey level reduced water activity and moisture in processed and fresh salsas.
- The reduction in water activity with increasing honey level may have caused extended shelf-life.

References

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Further Reading

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