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Department of Nutrition and Food Sciences

Sensory Properties Of Raw And Roasted White Button, Crimini, And Portobello Mushrooms

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Abstract

This study compared the sensory profiles of white button, crimini, and portobello mushrooms in both raw and cooked forms to gain an understanding of what aroma-active compounds are important for each type of mushroom and how the cooking method impacts the overall flavor profile of each. Ten participants were trained to recognize eleven of the primary flavor descriptors for mushrooms and the intensity of each descriptor for a quantitative descriptive analysis panel. References were made from chemical standards for each descriptor. The roasted, dark meat, and fried sensory attributes increased for all mushrooms when cooked compared to raw. Conversely, the hay, woody, and earthy sensory attributes decreased for all samples when cooked. The portabella mushroom sample showed the highest intensity of dark meat flavor when cooked. These results contributed to the growing body of research into how mushroom aroma compounds can be utilized for flavor formulation.

Introduction

- White button mushroom, crimini mushroom, and Portobello mushroom are all part of the Agaricus bisporus species just harvested at various stages of maturity
- Most of the literature for Agaricus bisporus focus on white button mushroom with little research into the sensory properties of the more mature varieties, crimini and Portobello (1, 2)
- This study researched how flavor, mouthfeel, and aroma profiles vary among white button, crimini, and Portobello mushrooms in both their raw and cooked forms
- The study used eleven sensory descriptors for both the aroma and the flavor profiles to quantify the flavor profile of all three mushrooms
- Panelists were trained for the panel by tasting and smelling the eleven descriptors in either plain or salt water solution
- These descriptors were characterized by one or more flavor chemicals which best represented the aroma or flavor of that descriptors.
- The flavor chemicals used for the descriptors as well as the concentration used were recorded in a table format to allow for reproducibility of the study's results (1, 3)

Research Objectives

- Generate a lexicon to describe raw and cooked mushroom flavor for each mushroom variety
- Make a table with reference standards that displays the formulation technique for reproducibility of results
- Discover what descriptors are important for each mushroom variety
- Find what attributes change from a raw to cooked mushroom

Research Methods

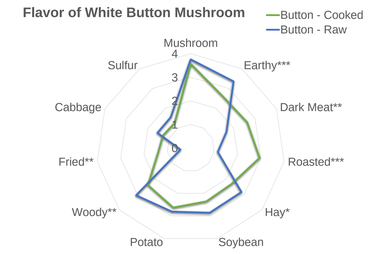
- Descriptors of mushroom flavor and aroma were chosen based on previous literature and QDA panelists input
- Reference standards were developed to best reflect the descriptors chosen
- Reference standards formulated from stock solution of various chemicals in propylene glycol
- Ten participants were trained using reference standards for Quantitative Descriptive Analysis (QDA) panel
- Data generated from QDA panel was processed using One-Way ANOVA method on SPSS

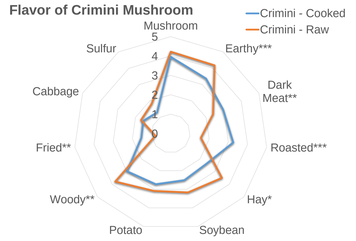
Results

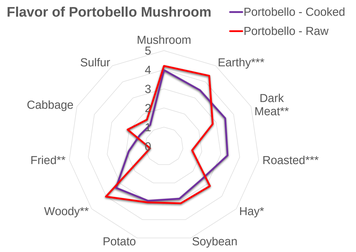
White Button Mushrooms

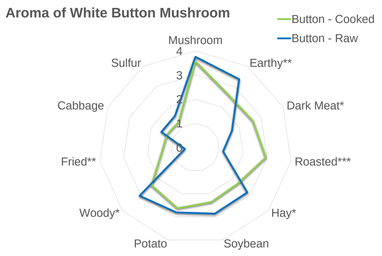
Crimini Mushrooms

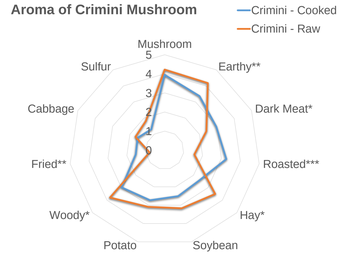
Portobello Mushrooms

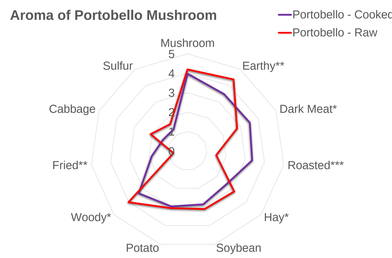


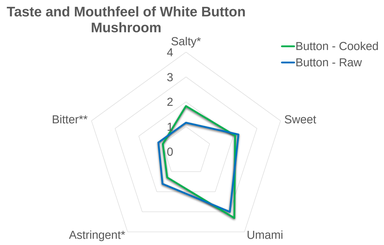


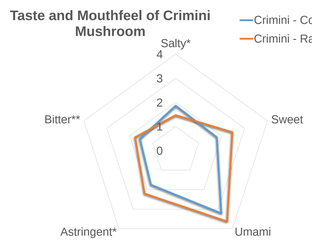


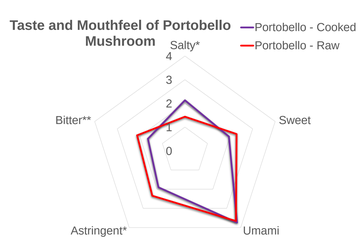












Charts 1 – 3 display the data from QDA analysis of the sensory descriptors for the flavor, aroma, mouthfeel, and taste of white button mushroom both in raw and in cooked form. These charts graphically depict that cooking the mushroom increased dark meat, roasted, and fried descriptors for the average person and decreased earthy, woody, hay, and soybean descriptors.

Charts 4 – 6: These charts graphically depict the sensory changes of the crimini mushroom sample when the sample is cooked versus when it is raw. The data shows a marked increase in the roasted descriptor and small decrease in the earthy descriptor.

Charts 7 – 9: The charts graphically show the changes in the sensory attributes for the Portobello mushroom sample when it is cooked versus when it is raw. Marked increase in dark meat and roasted descriptors when the sample was cooked as well as a marked decrease in earthiness.

Descriptors	Definition	References	Reference preparation	Intensity (1 – 10)
Mushroom	An aromatic generally associated with fresh raw mushrooms, with some characteristics described as damp earthy and musty. e.g., button mushroom.	1-octen-3-ol	Made stock solution (SS) of 1000 PPM by using 10 microliters of 1-octen-3-ol and adding propylene glycol (PG) to make 10 mL. Used 5 microliters of SS and added DI water to make 100 mL. 0.05 PPM solution	6
Earthy	A flavor used to describe the perception of clean wet dirt associated with root vegetable such as potatoes or beets.	3-pyropylidenephthalide	Made SS of 100 PPM by using 1 microliter of 3-pyropylidenephthalide and adding PG to make 10 mL. Used 2.5 microliters of SS and added NaCl (0.1%) to make 0.0025 PPM solution.	3
Dark meat	A flavor compound of roast beef, pot roast and cooked pork with aroma that is sulfurous and mildly alliaceous.	2-methyl-3-tetrahydrofuranthiol	Made SS of 100 PPM by using 1 microliter of 2-methyl-3-tetrahydrofuranthiol and adding PG to make 10 mL. Used 1 microliter of SS and added DI water to make 0.001 PPM solution.	4
Roasted	An aromatic that has the quality of roasted meat and vegetables undertones of roasted hazelnut and cocoa	2,5-dimethylpyrazine 2,3-diethyl-5-methylpyrazine	Made SS of 1000 PPM by using 10 microliters of 2,5-dimethylpyrazine and adding PG to make 10 mL. Same SS concentration for 2,3-diethyl-5-methylpyrazine. Used 70 microliters of 2,5-dimethylpyrazine SS and 30 microliters of 2,3-diethyl-5-methylpyrazine SS then added DI water to make 100 mL. 0.7 PPM 2,5-dimethylpyrazine and 0.3 PPM 2,3-diethyl-5-methylpyrazine.	5
Potato	Potato aroma associated with potato products (e.g. chips). Flavor is characteristic of boiled potato with sulfurous and earthy notes	methional	Made SS of 10,000 PPM by using 100 microliters of methional and adding PG to make 10 mL. Used 1 microliter of SS then added DI water to make 100 mL solution of 0.1 PPM.	5
Woody	Sweet, smoky wood aroma with notes of clove and tenancious woody spice. phenolic, vanilla	Eugenol guaiacol beta-caryrophyllene	Made SS of 1000 PPM by using 10 microliters of eugenol and adding PG to make 10 mL. Made SS of same concentrations for guaiacol and beta-caryophyllene. Used 40 microliters of eugenol SS, 80 microliters of guaiacol SS, and 50 microliters of eugenol SS then addded DI water to make 100 mL solution (E=0.4 PPM, G=0.8 PPM, b-C=0.5 PPM)	5
Fried	Fatty, vegetable oil with lard and tallow nuances of french fried potatoes	oleic acid	Made SS of 10,000 PPM by using 100 microliters of oleic acid and adding PG to make 10 mL. Used 100 microliters of SS then added DI water to make 100 mL solution of 10 PPM.	5
Cabbage	Aroma typically associated with cooked cabbage. Sulfurous, alliaceous, creamy with a surface-ripened cheese topnote and a clean savory meaty depth	methanethiol	Made SS of 1000 PPM by using 10 microliters of methyl thiobutyrate and adding PG to make 10 mL. Used 75 microliters of SS then added DI water to make 100 mL solution of 0.75 PPM	5
Sulfur	Sulfurous notes typical of savory products. Aroma and flavor associated with canned vegetables (e.g. corn)	dimethyl sulfide	Made SS of 1000 PPM by using 10 microliters of dimethyl sulfide and adding PG to make 10 mL. Used 50 microliters of SS then added DI water to make 100 mL solution of 0.5 PPM.	5

Table 1: Table of descriptors with definition of the flavor and the reference chemical used to make standards for the QDA panel. The intensity of each reference standard is also shown to increase reproducibility of this study's results.

Discussion

- Results showed few differences among the mushroom varieties
- Results indicated that the cooking process generated the greatest sensory changes in each mushroom variety
- In all samples the attributes of hay, woody, and earthy decreased when the sample was cooked
- The dark meat, roasted, and fried attributes increased for all mushroom varieties when the samples were cooked
- These parallel changes that occur in the cooking process help to understand how mushroom aroma active compounds can be used in the flavor industry
- Reference chemicals used to make standards for QDA panel contribute significantly to the growing body of research investigating mushroom flavor and sensory properties

Conclusion

- This study confirmed eleven different sensory descriptors to define mushroom aroma and flavor
- Woody, earthy, and hay descriptors decreased for all when the mushrooms were cooked suggesting that these are important attributes for raw mushroom flavor
- Roasted, dark meat, and fried descriptors increased for all when the mushrooms were cooked which suggests that these attributes are important for cooked mushroom flavor
- Understanding the importance of these attributes helps to understand how to use mushroom flavor compounds in the food industry

References

1. Myrdal Miller, A., Mills, K., Wong, T., Drescher, G., Lee, S. M., Sirimuangmoon, C., Schaefer, S., Langstaff, S., Minor, B., & Guinard, J.-X. (2014). Flavor-Enhancing properties of mushrooms in Meat-Based dishes in which sodium has been reduced and meat has been partially substituted with mushrooms. *Journal of Food Science*, 79(9), 1795-1804.
2. Aisala, H., Laaksonen, O., Manninen, H., Raittola, A., Hopia, A., & Sandell, M. (2018). Sensory properties of nordic edible mushrooms. *Food Research International*, 109, 526-536.
3. Singh, S., Ghosh, S., & Patil, G. R. (2003). Development of a mushroom-whey soup powder. *International Journal of Food Science and Technology*, 38, 217 - 224.

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