Initial investigation of the chemical contribution of hemp to beer aroma

Caitlyn Hunt and Dr. Drew Budner

Department of Chemistry, Coastal Carolina University

2022 ASBC Meeting

BREWING SUMMIT 2022
Providence, Rhode Island | August 14–16

A-11

Introduction

With the recent expansion of industrial hemp production, there has been a concomitant increased use of hemp in among commercial brewers. For example, prior to the growing season of 2017, South Carolina had zero hemp producers and for the 2019 growing season were 40, and for these 40 producers 161 different applications were submitted. It is important to point out that this is production of industrial hemp, not marijuana. Industrial hemp has a tetrahydrocannabinol, THC, level below 0.3 %. With this increased production of hemp, there is an incentive to find new markets for both the hemp material and as well as its byproducts such as CBD oil. There is also an increase in the popularity of using CBD oil to address a wide range of health concerns. The popularity of hemp and CBD oil has recently expanded into the brewing industry and several producers now offer beers that are flavored with hemp. From the producers side there is an expressed interest in finding increased markets for both raw hemp and hemp following CBD oil extraction (defatted hemp).

Objectives

1) Initial Investigation of the Chemical Contribution of Hemp to Beer Aroma

2) Investigation of the volatile and semi-volatile compounds originating from hemp are transferred when added to during production.

3) Compare the volatile and semi-volatile compounds transferred into beer from raw and defatted hemp.

Brewing

The Maillard Malts® Amber Malt Extract Syrup was added to approximately 6.5 gallons of water and boiled for one hour. Wort was cooled, and a volume of 5 gallons was collected. From which three 3 L aliquots were transferred into clean, sterile one-gallon fermenters. A single US-05 yeast was pitched to each of the aliquots and the fermenters were sealed with an airlock. Two different hemp approaches were used. The first was 8g of defatted hemp added to the fermenters at time of pitching and the second was 80g of defatted hemp added to the wort at start of boil.

GCMS Analysis

From each fermenter, a 10 mL aliquot of beer was placed into a 20 mL headspace sample vial containing 3 g NaCl and 50 µL internal standard (200 mg/L 2-heptanol). The sample was thermally conditioned at 40 ˚C for 10 minutes then a 50/30 DVB/CAR/PDMS Stableflex fiber was exposed to the headspace for 30 minutes with agitation at 250 RPM. Fibers were thermally desorbed into in a Shimadzu QP 2010 SE GCMS. Analysis conditions are based on optimized conditions described by Saison *et al.*[1]

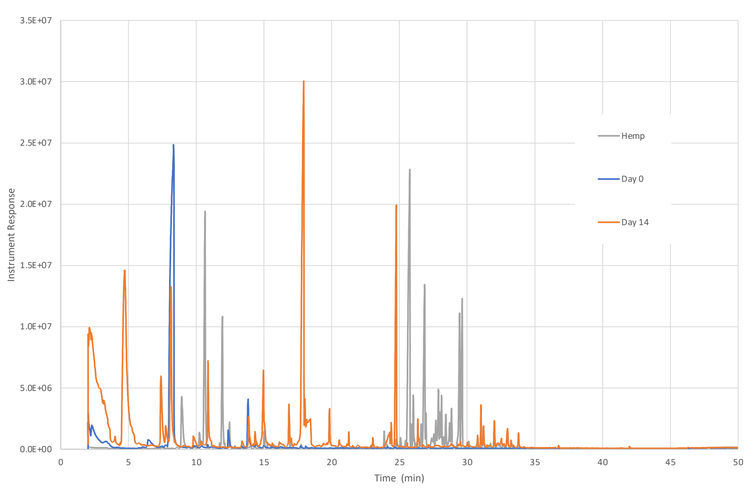

Figure #1: The GCMS chromatograms showing the volatile and semi-volatile compounds present in the heated industrial hemp [gray], the freshly brewed beer (at start of fermentation) [blue], and beer that was fermented in the presence of industrial hemp (orange).

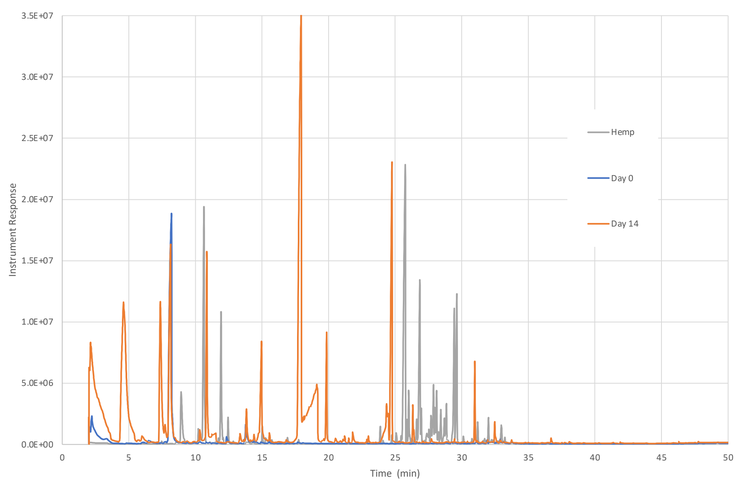

Figure #2: The GCMS chromatograms showing the volatile and semi-volatile compounds present in the heated industrial hemp [gray], the freshly brewed beer with industrial hemp (at start of fermentation) [blue], and fermented beer brewed with industrial hemp (orange).

Table 1: A list of compounds found in relatively high concentration in the heated raw industrial hemp and its presence (X) or absence in beer following fermentation with hemp

Retention Time (min)	Industrial Hemp Compounds	Dry Hemped Beer
8.95	.beta.-Pinene	
10.29	Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-, (1S)-	
10.7	.beta.-Myrcene	
11.92	D-Limonene	x
12.46	.gamma.-Terpinene	x
25.76	Caryophyllene	x
26.87	Humulene	x
27.9	Alloaromadendrene	x
28.6	sesquicineole	x
29.7	9-Cedranone	x
32	8-epi-.gama.-eudesmol	x

Table 2: A list of compounds found in relatively high concentration in the heated raw industrial hemp and it presence (X) or absence beer brewed with a hemp addition during brewing at start and/or end of fermentation

Retention Time (min)	Industrial Hemp Compounds	Hemp Pre-fermentation	Hemp Post-fermentation
8.95	.beta.-Pinene		
10.29	Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-, (1S)-		
10.7	.beta.-Myrcene		
11.92	D-Limonene	x	x
12.46	.gamma.-Terpinene		x
25.76	Caryophyllene	x	
26.87	Humulene	x	x
27.9	Alloaromadendrene	x	
28.6	.gamma.-Elemene	x	
29.43	9-Cedranone	x	x
32	8-epi-.gama.-eudesmol	x	x

Discussion

A subset of 11 compounds originating from defatted hemp were chosen due to their relatively high concentration. The initial investigation showed that there was a transfer of volatile and semi-volatile compounds form defatted industrial hemp into beer. The method of hemp addition played a role in the presence of compounds. A larger number of compounds were found when hemp was added post-boil and it is important to note that not all 11 compounds were transferred into the beer. Some compounds were consumed or modified in the fermentation process or storage.

Further work will include the quantification of the compounds seen and the exploration of additional compounds that were present but not looked at in this study. In addition, the investigation of hemp in an aqueous solution in the absence of malt and looking at industrial hemp as a grain fermentation source will build upon the research in this study.

References

1. Saison, D.; De Schutter, D. P.; Delvaux, F.; Delvaux, F. R. Optimisation of a Complete Method for the Analysis of Volatiles Involved in the Flavour Stability of Beer by Solid-Phase Microextraction in Combination with Gas Chromatography and Mass Spectrometry. *J. Chromatogr. A* **2008**, *1190* (1–2), 342–349.

Acknowledgments

Thank you to Coastal Carolina University for funding this work and Sycamore Biopharma Inc for supplying defatted hemp.