



Development and Evaluation of a Hemp Flake Extruded Snack

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Abstract

A formula was developed for an extruded snack puff using hemp flakes, a by-product after the cannabidiol (CBD) oil is expressed from hemp seeds. The hemp flakes have residual oil which may impart health benefits. The goal is to develop an extruded snack puff to meet health desires of consumers with sensory acceptability and functional benefits.

Heavy metal levels were determined to ascertain safety of the raw ingredients. Four heavy metals were not detected or were present only at low concentrations. Copper, cobalt and aluminum were found and levels conformed to FDA standards.

Expansion ratio was significantly affected by temperature of the barrel and screw speed. Hemp flake addition to the formula was also observed to have an impact on increased expansion.

Anti-oxidant potential was found to be highly retained after the extrusion process (89–93%). The best process that produced expanded snacks with quality parameters were high screw speed and high temperature. Expansion was observed to be positively affected by adding hemp.

Introduction

CBD in hemp has become an interesting ingredient for health benefits among consumers worldwide. Its bioremediation properties demand for a check of its safety prior to using it as a food ingredient.

Snacking can be an environmental influence of obesity as consumers often eat snacks instead of meals; with taste and convenience being major influencers of snack choices.

Relaxation and improving the quality of life are major reasons for cannabidiol (CBD) oil use and can be coupled with snacking for improved health and relaxation.

Some research ongoing in other areas of use such as feeding livestock and soil compost. There is limited information on hemp application in foods.

Objectives

The overall goal of this study was to develop a hemp flake containing extruded product that will be acceptable and healthy.

The specific objectives were assessment of heavy metal content of hemp flakes, formula development for extrusion and assessment of product physicochemical properties.

Materials and Methods

Heavy metal contents determination was conducted with inductively coupled plasma-optical emission spectrometry (ICP-OES) on Pb, Ar, Cd, Co, Al, and Cu. Produced samples were compared to commercially available products (NL, FL, FC, and JH).

Flakes were added at 0 and 10% at the expense of yellow corn flour to a base formula and extruded with a Brabender twin screw extruder (South Hackensack, NJ).

Each formula was evaluated at MC 20% and 25%. Extruder parameters were 120 or 140°C for zone 4 with zones 1-3 being 100, 110, and 120°C, respectively. Extruder screw speeds were 100, 120, or 140rpm. The extruder die was 3mm diameter.

Antioxidant studied were TPC (Singleton,1999), FRAP (Benzie and Strain, 1999) and DPPH (Brand-Williams, 19995).

Table 1. Extrusion formula : Modification of Pitts *et al.*, (2014) method.

Ingredient	Weight per kg	Percent of ingredients (%)
Yellow corn flour	728	72.80
Wheat flour	250	25.00
Salt	10.05	1.025
Sugar	1	0.10
Guar gum	0.5	0.05
Arabic gum	0.25	0.025



Fig. 1 Lab scale twin screw extruder (C.W. Brabender, South Hackensack, NJ) with counter-rotating twin screws



Fig 2. Extrudate with 0% hemp (top insert) and 10% hemp (bottom insert) inclusion into the formula

Results

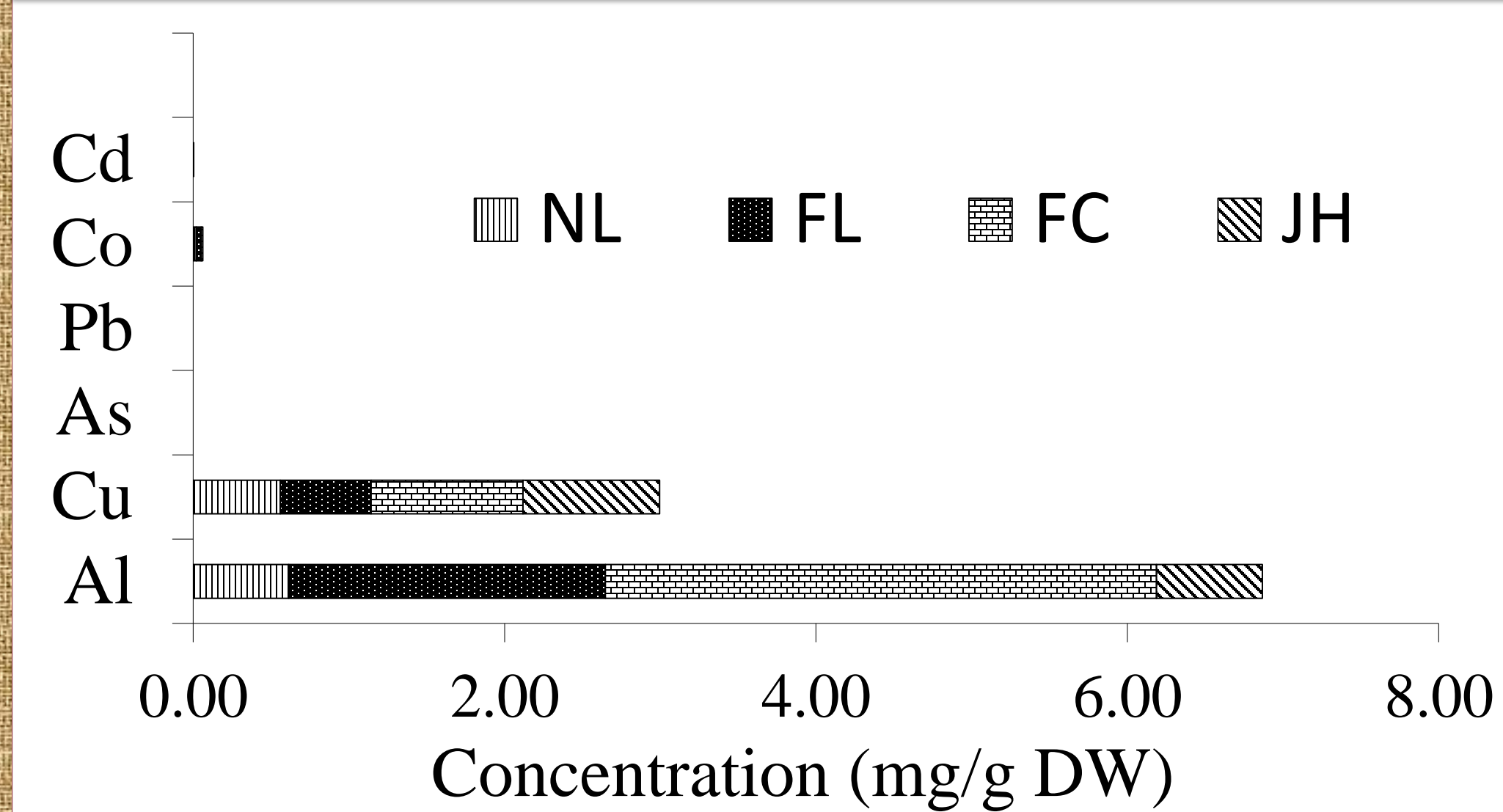


Fig. 3 Heavy metal content of hemp by-product FL compared with heavy metal levels in three commercial hemp products FC, JH, and NL (names not provided so as to not identify commercial products)

	MT (Nm)	SME (kJ/kg)	SS (rpm)	Temp (°C)	WSI (g/g)	MC (%)	ER
MT	1.00	0.64	0.14	0.25	0.23	0.11	0.88
SME		1.00	0.56*	0.32	0.39	-0.76*	0.67*
SS			1.00	0.44	0.50°	0.39	0.33
Temp				1.00	0.43	0.34	0.49
WSI					1.00	-0.67*	-0.39*
MC						1.00	-0.99**
ER							1.00

Fig 4. Correlation matrix between extruder and extrudate parameters (* significant at p ≤ 0.05, * significant at p ≤ 0.01, **significant at p ≤ 0.001) MT = motor torque, SME = specific mechanical energy, SS = screw speed, Temp = temperature, WSI = water solubility index, MC = moisture content, ER = expansion ratio

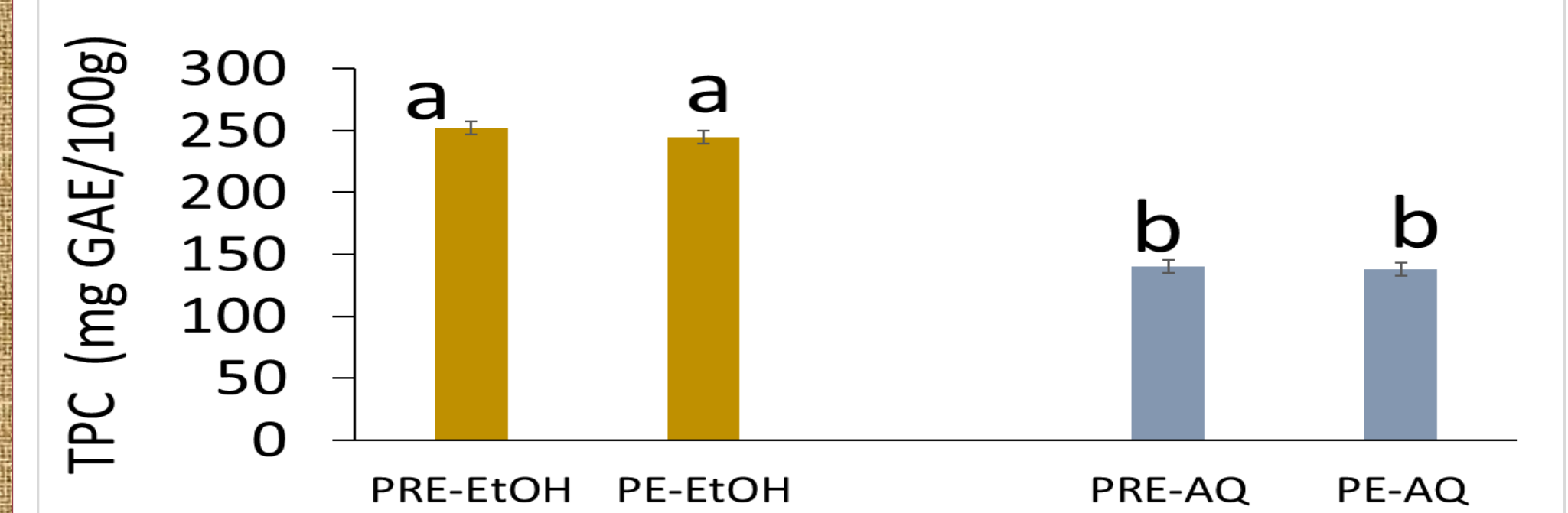


Fig 5. Pre and post extrusion comparison for total polyphenol content when extracted with ethanol (EtOH) or water (AQ); significant at p ≤ 0.05

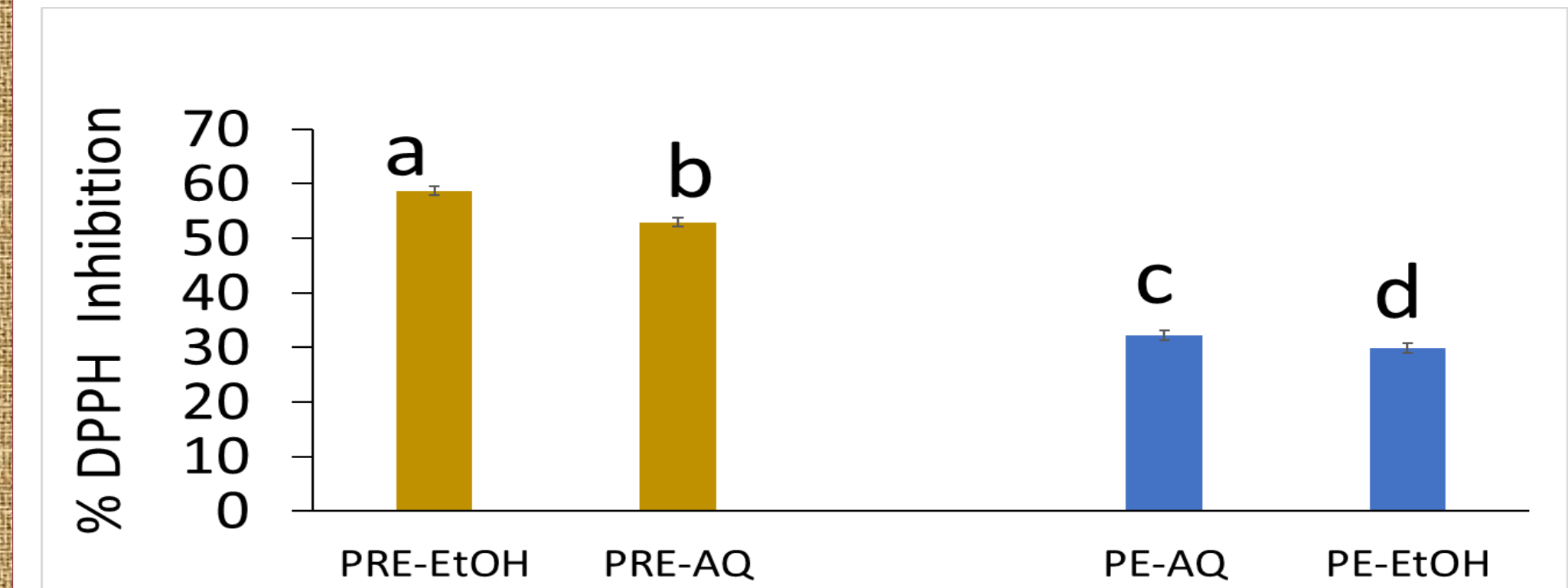


Fig 6. Pre and post extrusion comparison for DPPH inhibition when extracted with ethanol (EtOH) or water (AQ); significant at p ≤ 0.05

Discussion

- Contrasted findings in this research are the way extruder screw speed affects expansion.
- Increased screw speed known to reduce residence time of the material within the extruder in general with reference to literature.
- However, in this work it was observed that increasing screw speed rather produced well cooked and significantly expanded snacks.
- Further, addition of hemp flakes exhibited significant increases in expansion, hitherto absent with the formula alone.
- There might be a constituent of the hemp flake that affects the plasticized melt that improved the bubble formation after the product exits the die.
- We intend to further investigate on what specific component within hemp flakes is responsible and if there is a point at which it fails in expansion.
- It is proposed that gums may have degraded during extrusion and behaved like starches, thereby promoting extra expansion.

Conclusion

Hemp flakes were proven to be valuable in nutrition and health as well as safe for application as a food ingredient.

Successful potential alternative, nutritious snacks could be made from hemp industry by-products.

Products may be recommended to combat obesity and other health related diseases.

Extrudates produced showed potential healthy snack for consumer acceptability. Extrusion conditions that favor hemp puffs were low moisture content (20%) increased screw speed (140rpm) and die temperature (140°C).

References

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