

Development of a processing method to obtain high-value products from sorghum and corn distiller's dried grains with solubles (DDGS)

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Introduction/Problem Statement

Real value of corn and sorghum DDGS is underestimated

Sorghum DDGS

Corn DDGS



Natural wax



Health and wellness-promoting food ingredients & nutraceuticals: carotenoids, tocols, phytosterols

Increasing applications

Increasing wax prices

Dwindling waxes supply

Growing demand for alternative natural wax



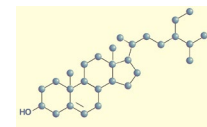
Carnauba wax

Sorghum DDGS is a promising alternative source for natural wax.

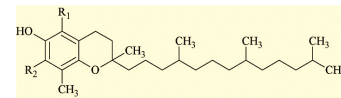
Corn DDGS



Phytosterols



Tocopherols



However, there is a critical need for a “clean” and efficient method to obtain high-purity wax from sorghum DDGS and high-value minor lipids from corn DDGS.

Goal and Objectives

Goal:

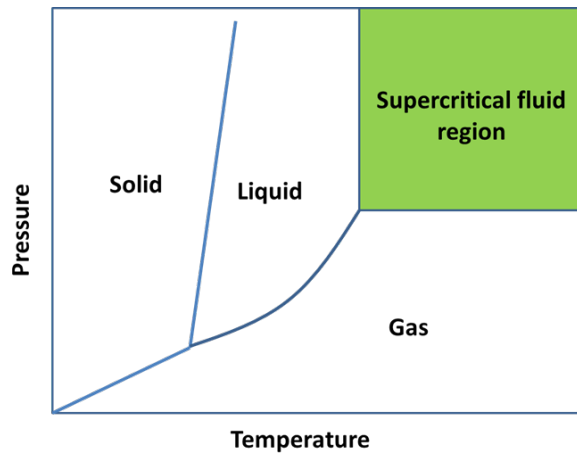
To develop an optimized processing method based on supercritical carbon dioxide (SC-CO₂) technology to obtain high-quality wax and lipids containing bioactives from sorghum and corn DDGS, respectively.

Specific objectives:

- To determine the effect of extraction method on the extract yield of sorghum and corn DDGS.
- To determine the effect of modifying SC-CO₂ with ethanol on the extraction behavior, total lipid yield, and minor lipid components composition of corn DDGS.
- To determine the wax content of the extracts from sorghum DDGS.
- To purify the wax extracts using a simple ethanol washing and centrifugation process.

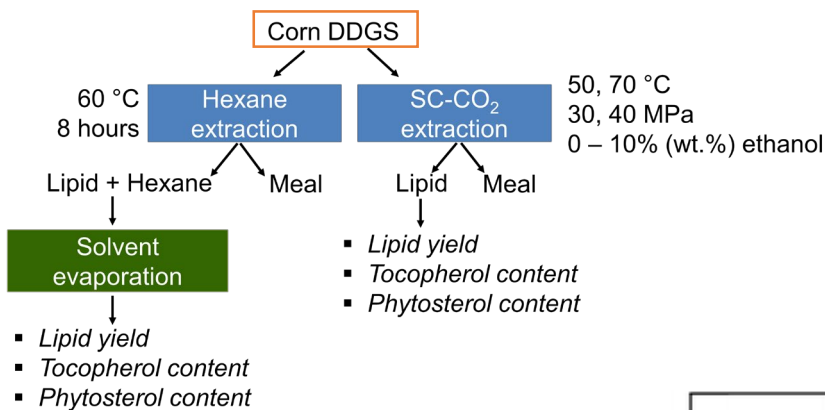
Materials and Methods

Supercritical Fluids

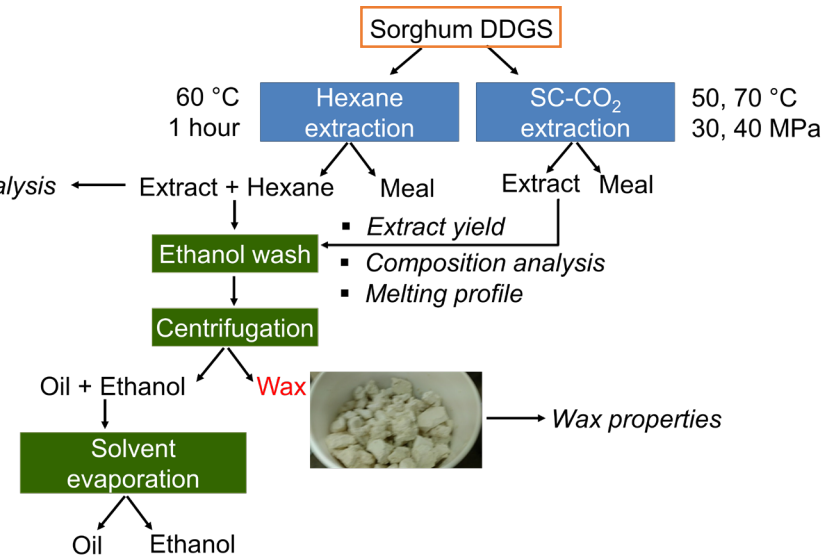


Advantages of processing with SC-CO₂

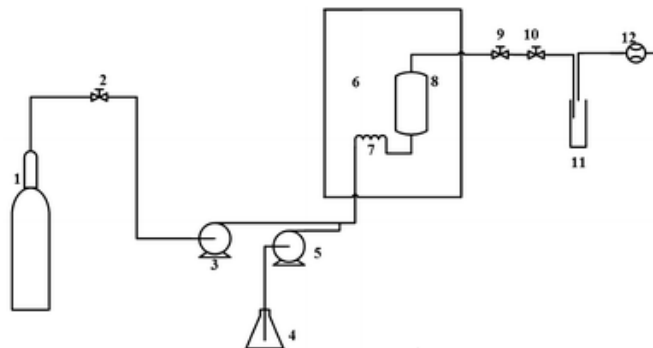
- CO₂ is non-toxic, abundant, and inexpensive.
- Moderate critical pressure and temperature (31 °C, 74 bar).
- Higher yield.
- Shorter extraction time.
- Ease of separation upon depressurization.
- Environmentally-friendly process.
- No solvent residue in products.
- “Clean” products can be obtained.



- *Extract yield*
- *Composition analysis*
- *Melting profile*



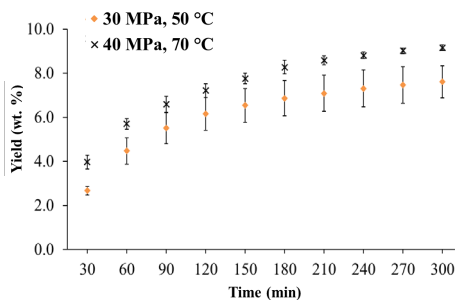
Schematic diagram of the SC-CO₂ extraction unit.
(Belayneh et al., 2017)



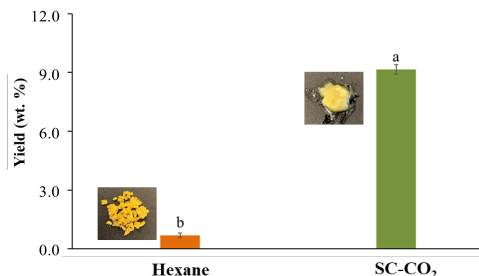
Results and Discussion

Sorghum DDGS

SC-CO₂ extraction



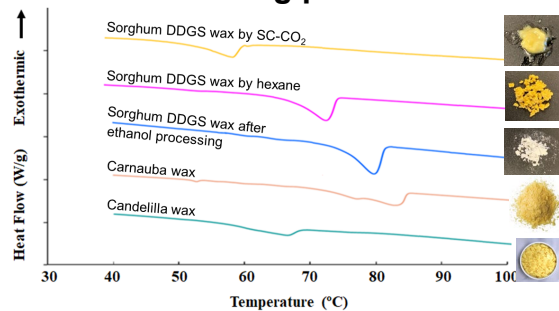
Hexane vs. SC-CO₂ extraction



Composition of the extracts

Extraction method	Composition (wt. %)		
	Polar	Oil	Wax
SC-CO ₂	ND	46.5 ± 0.1 a	53.5 ± 0.1 b
Hexane	ND	40.4 ± 0.1 b	53.5 ± 0.1 b

Melting profile

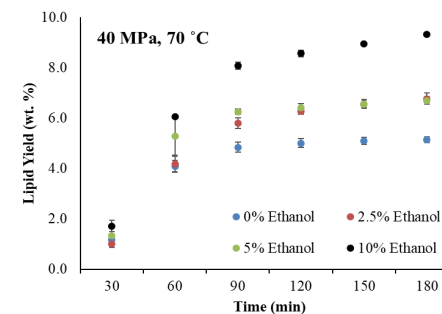
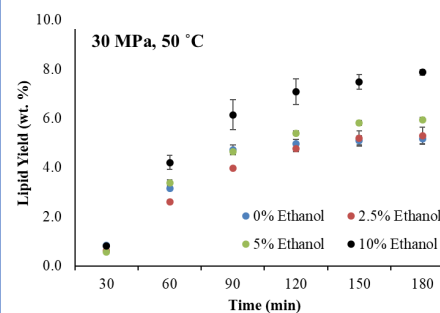


Effect of the ethanol wash on the wax properties

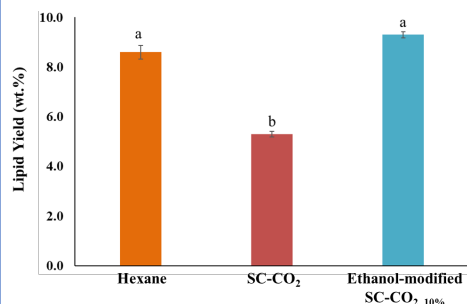
Property	Candelilla wax	Carnauba wax	Sorghum wax extracts	Sorghum wax extracts after ethanol wash
Hardness	2	1	40	2
Acid number	4.8	2.6	20.0	3.3
Iodine number	18.5	11.7	59.4	23.6

Corn DDGS

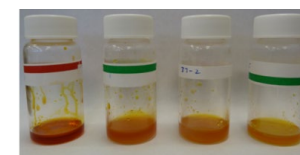
SC-CO₂ extraction



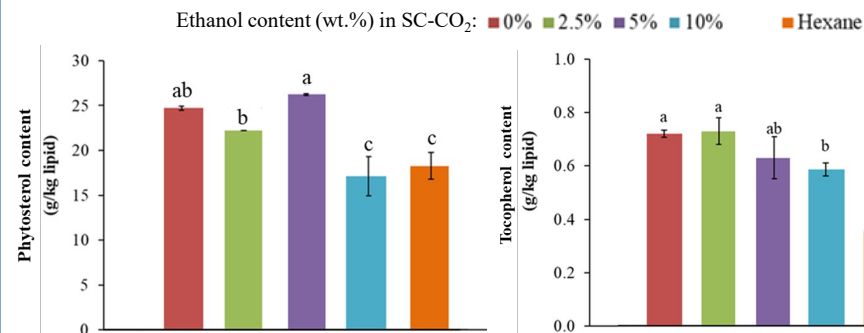
Hexane vs. SC-CO₂ extraction



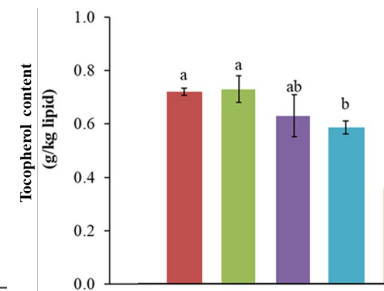
SC-CO₂-extracted corn DDGS lipids



Phytosterol content



Tocopherol content



Significance and Anticipated Impact

- SC-CO₂ technology is a green technology to extract high-value products from sorghum and corn DDGS.
- Ethanol-modified SC-CO₂ extraction is a promising method to obtain corn DDGS extracts enriched with high-value health and wellness-promoting lipophilic bioactives.
- Sorghum wax is an alternative natural and may reduce U.S. dependence on non-renewable petroleum derived waxes or natural wax imports.
- The ethanol wash is a simple and clean process to obtain high-purity wax from sorghum; minimizes processing steps, solvent and energy requirements.
- Obtaining high-purity wax from sorghum DDGS will add value to sorghum DDGS and expand applications of sorghum.

Thank you!