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Short communication

Citrullus colocynthis: source of biodiesel

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ABSTRACT

Citrullus colocynthis (L.). Schrad, is a member of the botanical family of Cucurbitaceae and is commonly called coloquinte or "desert gourd", Handhal (Arabic) or Alkad (Tamahaq). This plant is known for its high oil content; it is a source of biodiesel and a real substitute for conventional diesel. Biodiesel is defined as a chemical alteration of vegetable oil to match the characteristics of the engine. The transesterification reaction is the most common method for converting coloquinte oil into esters and glycerol. The purpose of this communication is to draw attention to the biodiesel produced by coloquinte, which has been widely described in the literature.

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1. Introduction

The concept of using vegetable oil as a source of biodiesel is not new. The first fuel ever developed was by Rudolf Diesel in 1895 [1]. Biodiesel, also known as natural diesel, may well replace fossil-based diesel in the future. It is defined as the chemical change of vegetable oil (fuel injection, atomization and atomization system) that corresponds to the characteristics of the engine [2]. It can be produced from vegetable oil or animal fat through a transesterification process. The latter is defined as an intermediate reaction between oil and short-chain alcoholic fats (methanol, ethanol and propanol) in the presence of a suitable catalyst, with higher yields [3].

Citrullus colocynthis (L.). Schrad (coloquinte) is known as "desert gourd", Handhal (Arabic) or Alkad (Tamahaq). It belongs to the cucurbit family and is known for its high protein content (35%) and essential oils (50%) contained in the seed [4]. A number of studies have shown the species' interest in renewable energy [1,5,6]. Compared to traditional diesel, biodiesel produced by coloquinte can be used as an alternative fuel with better performance and lower emissions [1]. Chavan et al. [2] described coloquinte as the best fresh raw material for biodiesel production.

It is in this perspective that a comprehensive bibliographic work has been carried out to generate interest in coloquinte as a source of renewable energy.

2. Materials and Methods

2.1. Plant Material

Coloquinte is an herbaceous plant in the Cucurbitaceae family. It has creeping stems with globular fruits and large, rough leaves. The seeds are small (7-9 mm long) ovoid in shape and slightly rounded, smooth, yellow or brown in color (Fig. 1). In Algeria, in the Ahaggar, this species is mainly found in wadi beds, lavatories and floodplains, on sandy, sandy-silty or sandy-clay soils [7].

Fig 1. Photographs of fruits and seeds of *Citrullus colocynthis*

2.2. Transesterification

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The oil extracted from the seeds of the coloquinte cannot be directly used as a fuel source due to its high viscosity. For this purpose, it must first undergo a dissolving of the acids with methanol to reduce the load of free fatty acids (AGL). In the second step, the transesterification reaction is performed in the presence of methanol and a basic catalyst (Fig.2) to form ester and glycerol [8]. It is the reaction of an ester on an alcohol to give another ester. It is a reversible reaction, catalyzed by an acid or a base.

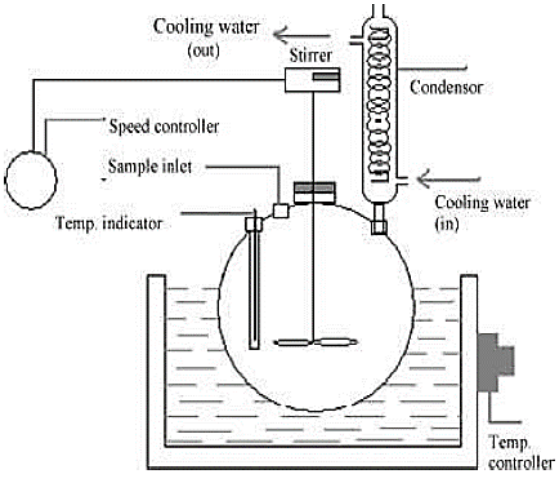

Fig 2. Diagram of the experiment of transesterification of coloquinte oil [2].

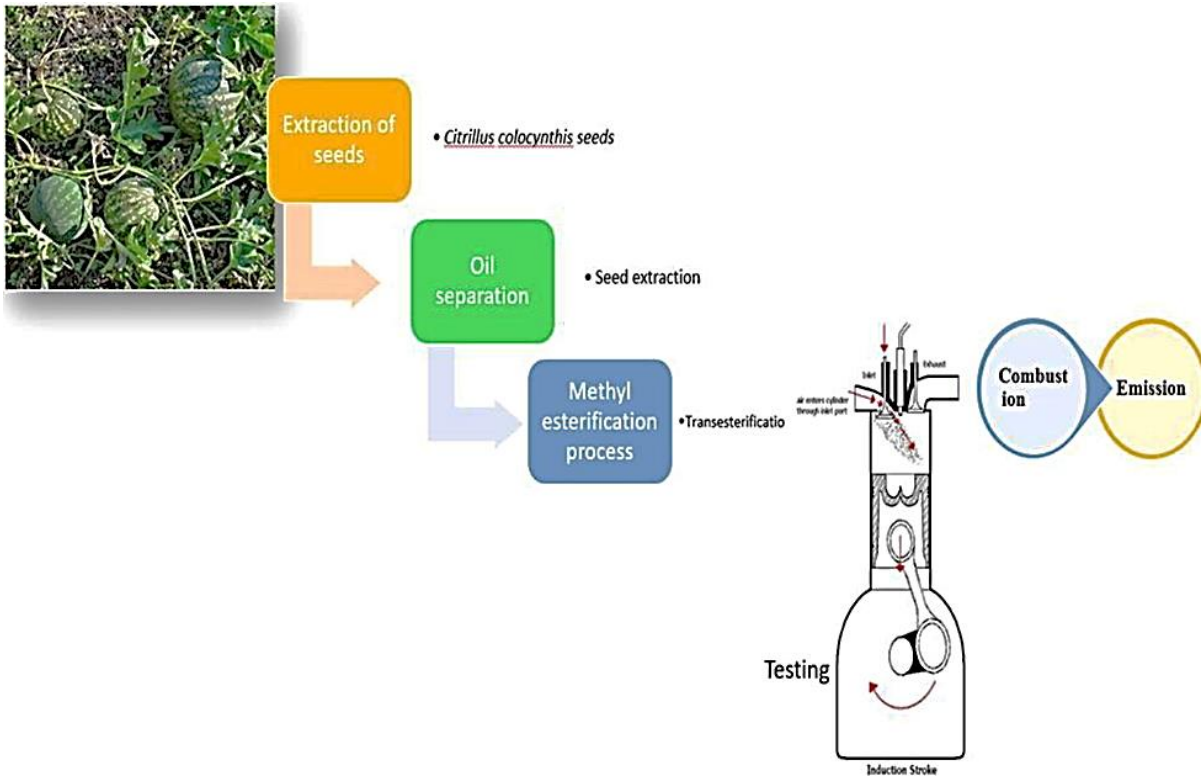

Fig 2. Graphical abstract of Enzymatic lipase-based methyl esterified *Citrullus colocynthis L.* biodiesel for improved combustion, performance and emission characteristics [16]

3. Results and Discussion

The results presented in Table 1 address the importance of switching from biodiesel to diesel. The biodiesel from the experimental studies is obtained by the intrinsic method from *Citrullus colocynthis*, by the transesterification process. Infact, Giwa et al. [5] described for the first time the method of methylesterification of coloquinte seed oil. This involves pre-drying crude oil prior to the transesterification reaction. The latter is the most common method of biodiesel production and has been widely used to reduce the viscosity of triglycerides [2]. Moreover, studies show that biodiesel parameters are better than those of conventional diesel in terms of density but especially in terms of viscosity. Indeed, according to the table above, we noticed that the viscosity after the transesterification reaction was reduced by an average of eight times. In addition, the experiments conducted by Sivokumar et al. [10] showed the real potential of biodiesel on the performance of diesel produced through the transesterification of coloquinte oil. In addition, a study conducted by Alloune et al [14] showed that the physico-chemical properties and combustion characteristics of biodiesel produced from coloquinte are close to those of conventional diesel fuel. On the other hand, biodiesel further reduced hydrocarbon emissions by up to 50%.

However, recent research on coloquinte biodiesel has shown that the transesterification of coloquinte oil can be improved to produce biodiesel with a lipase-based enzymatic process (Fig. 2) to reduce CO and HC emissions [15, 16].

Table 1. Physico-chemical characteristics of oil and biodiesel produced from coloquinte

Parameters	Physico-chemical characteristics	
	Seeds oil	Biodiesel
Density (gm/cc@20°C)	0,902 et 0,930 [1, 2, 9, 10]	0,88 [1, 9, 10, 11]
Viscosity (Cst@40°C)	19,99 à 40,2 [2, 12]	3,91 à 5,86 [1, 9, 11]
Free fatty acid (%)	0,49 à 1,57 [9, 12, 13]	0,48 [11]
Acidity (KOH mg/mg)	0,98 à 3,14 [9, 12]	-

4. Conclusion

Coloquinte oil is a good source of raw material for biodiesel production thanks to multiple advantages:

- Botanically speaking, this species has a short life cycle (6 months), its fruit can contain 1000 seeds therefore a greater oil production. Often found in semi-arid and arid areas, it is a drought - resistant plant.
- Very beneficial physico-chemical properties due to its lower free fatty acid composition reflecting low viscosity and higher quality biodiesel production
- Technically, biodiesel degrades four times faster than diesel. The oxygen in biodiesel improves the process of biodegradation and thus engine efficiency [17].
- The production of biodiesel generates very little waste and therefore non-polluting to the environment
- In economic terms, biodiesel is a very important substitute for traditional diesel.

Conflict of Interest

The author declares that they have no conflict of interest

References

1. Pal S, Kachhwaha S, Maji M, Babu, Thumba (*Citrullus colocyntis*) seed oil: A sustainable source of renewable energy for biodiesel production. *J. Sci. Ind. Res.* 2010,69:384-389.
2. Chavan S.B, Kumbhar R.R, Sharma Y.C. Transesterification of *Citrullus colocynthis* (Thumba) oil: optimization for biodiesel production. *Adv. Appl. Sci. Res*. 2014,5: 10-20.
3. Felizardo P, Neiva Correia M.J, Raposo J, Mendes J.F, Berkemeier R, Bordado J.M. Production of biodiesel from waste frying oils, *Wast. Mana.* 2006, 26:487-94
4. Achu M, Fokou E, Tchiegang C, Fotso M, Tchouanguep F. Nutritive value of some cucrbitaceae oilseeds from different regions in Cameron. *Afri. J. Biotechno*. 2005, 11:1329-1334.
5. Giwa S, Luqman C.A, Adam N.M. Investigating "Egusi" (*Citrullus colocynthis* L.) seed oil as potential

biodiesel feedstock, *Energies*. 2010,3;.4: 607-618.
6. Kiran M., Aswathy P.J, Mohammad S, Neeru S, Nanduri K.R. Seed Dormancy and Effect of Salinity on Germination of *Citrullus Colocynthis*. *Inter. J. Environ. Sci. Develop*. 2014,5;6:566-569.
7. Sahki A, Sahki R. Handbook , le Hoggar, promenade botanique . ed. ESOPE, 2004, pp. 166-167.
8. El-Mashad Hamed M, Zhang R, Roberto J, Avena-Bustillos. "A two-step process for biodiesel production from salmon oil." *Biosys Engin.* 2008, 99;2: 220-227.
9. Giwa S, Luqman C.A, Adam N.M. Fuel properties and rheological behavior of biodiesel from egusi (*Colocynthis citrullus L*.) seed kernel oil. *Fuel. Proces. Techno*. 2014, 122:42-48.
10. Sivakumar G, Vail D.R, Xu J, Burner D.M, Lay J.O, Ge P.J. Weathers, Bioethanol and biodiesel: Alternative liquid fuels for future generations, *Engin. Life. Sci.* 2010,10;1: 8-18.
11. Kaushik V, Jakhar O.P, Mathur Y.B. Experimental Performance Analysis of Lower Concentration Blends of Thumba Methyl Ester with Diesel. *Inter. J. Soft. Comput. Engineer*. 2004,4:42-48.
12. Nehdi I.A, Sbihi H, Tan C.P, Al-Risayes S.I. Evaluation and characterisation of *Citrullus colocynthis* (L.) Schrad seed oil: Comparison with *Helianthus annuus* (sunflower) seed oil. *Food. Chem.* 2013,13;.2:348-353.
13. Ziyada A.Z, Elhussien S.A. Physical and chemical characteristics of *Citrullus lanatus* var. colocynthoide seed oil. *J. Phy. Sci.* 2008,19;2:69-75.
14. Alloune R, Balistrou M, Awad S, Loubar K, Tazerout M. Performance, combustion and exhaust emissions characteristics investigation using *Citrullus colocynthis* L. biodiesel in DI diesel engine. *J. Energy. Instit.* 2018, 91(3): 434-444.
15. Sivalingam A, Kandhasamy A, Senthil Kumar A, Perumal Venkatesan E, Subramani L, Ramalingam K., ... & Venu H. (2019). *Citrullus colocynthis*-an experimental investigation with enzymatic lipase based methyl esterified biodiesel. *Heat. Mass. Transfer.* 2019, 55(12): 3613-3631.
16. Sheng Y, Brindhadevi K, Eed E.M, Xia C, Chi N.T.L. Enzymatic lipase-based methyl esterified Citrullus colocynthis L. biodiesel for improved combustion, performance and emission characteristics. *Fuel*, 2022, 307: 121899.
17. Kale P.T, Ragit S.S. Optimization of Babassu (*Orbignya sp*) biodiesel Production from babassu oil by Taguchi Technique and Fuel Characterization. *Inter. J. Petrol. Sci. Tech*. 2017, 11;1: 35-50.

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