Near-infrared spectroscopy for analysis of oil content and fatty acid profile in *Jatropha curcas* L. flour

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Introduction

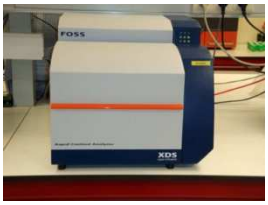
Jatropha curcas L. **(JCL) is a multipurpose tropical shrub that belongs to the Euphorbiaceae family. It has its centre of origin in Central America and grows in tropical and subtropical regions throughout Africa, India and South East Asia. It is often planted as living fence, to reclaim wasteland or used to control soil erosion. JCL is rather drought resistant and is cultivated for its seeds that have high oil content up to 50%. The oil contains several toxic compounds, thus it is non-edible and can be use as a high quality biodiesel, as bio pesticide, in soap production and in oil lamps. While JCL has ideal oil quality for biodiesel production, it is still an undomesticated plant and genetic variability and environmental conditions have a large impact on oil quality. As improved plant material is not widely available, it's all the more important to screen seeds with high oil content for industrial application of biodiesel and to know their fatty acid composition for quality breeding. The objective of this study was to find a quick way to measure oil content and fatty acid composition of JCL seed meal using near infrared spectroscopy.**

Material and methods

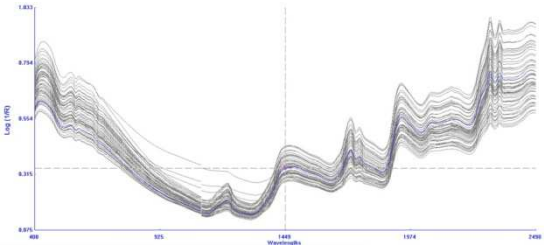
Jatropha curcas **L., a non-edible oil-bearing plant, considered to be a sustainable alternative to fossil fuels**

277 seed samples, each from a single plant, were harvested in Senegal during 2010

Each sample was ground using an ultracentrifugal grinding mill to pass a 1-mm ring sieve



All samples were scanned twice when placed in a 1/4-rectangular sample cell by near-infrared reflectance spectroscopy



The spectral data were recorded (log1/R) within the wavelength range 400-2498nm by 2 nm steps

58 samples were randomly selected for external validation and analyzed by wet chemistry analyses

Calibration equations were developed by multiple linear regression analysis (MLR) using WinISI IV software.

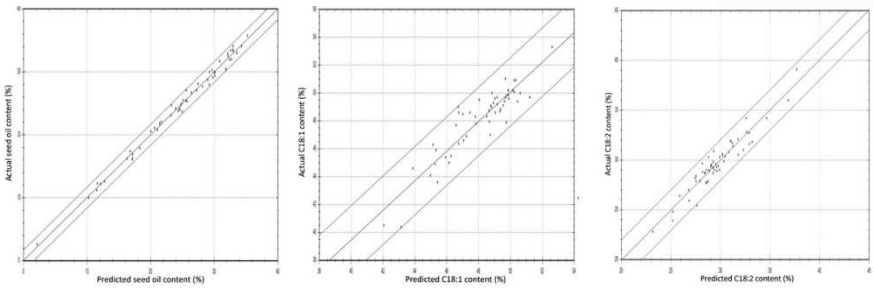
Results and discussion

Calibration equations were developed by multiple linear regression analysis (MLR) using WinISI IV software.
99% of the oil is composed of four principal fatty acids including oleic, linoleic, palmitic and stearic acids. The two unsaturated fatty acids, oleic and linoleic, represented 78% of the oil content, the two saturated fatty acids, palmitic and stearic, 21%. The seeds showed large variability for oil content, ranging from 5,34 to 45,35% in calibration set. Highest variability for fatty acids was observed for linoleic and oleic acid, ranging from 22,10-37,51% and 41,79-54,82% respectively, followed by palmitic, stearic, palmitoleic and least in linolenic acid.

Trait	N	Mean	Range	SD
Oil content	55	25,35	5,34-45,35	6,67
Palmitic (C16:0)	56	14,54	11,17-17,92	1,12
Palmitoleic (C16:1)	58	1,00	0,42-1,58	0,19
Stearic (C18:0)	54	6,49	4,54-8,43	0,65
Oleic (C18:1)	57	48,30	41,79-54,82	2,17
Linoleic (C18:2)	56	29,80	22,10-37,51	2,57
Linolenic (C18:3)	53	0,25	0-0,53	0,09

For the oil content and the individual fatty acids, coefficients of determination (R^2) values from calibration statistics varied from 0,60 to 0,99. Reliable equations were developed for oil content (R^2 = 0,99; RPD = 9,42), linoleic acid (R^2 = 0,89; RPD = 2,85) and oleic acid (R^2 = 0,81; RPD = 2,19). The high potential for determining oil content by NIRS can be of huge utility for screening a large number of samples to determine oil content and fatty acid composition (linoleic and oleic acid) in breeding programs for development of high quality JCL oil. The NIRS method performed poorly for palmitic and stearic acids that occur in lower concentrations in the seeds, with values of R^2 of 0,60 and 0,62 respectively. However, these equations would still be reliable enough to identify seed variants with significantly different fatty acid compositions.

	Calibration performance			External validation	
Trait	R2	SEC	SECV	SEP	R2
Oil content	0,99	0,69	0,71	0,80	0,99
Palmitic (C16:0)	0,60	0,71	0,74	0,82	0,67
Palmitoleic (C16:1)	0,66	0,11	0,12	0,15	0,44
Stearic (C18:0)	0,62	0,40	0,41	0,47	0,68
Oleic (C18:1)	0,81	0,95	0,99	1,02	0,84
Linoleic (C18:2)	0,89	0,85	0,90	1,06	0,93
Linolenic (C18:3)	0,78	0,04	0,04	0,05	0,87



Conclusion

NIRS could be a promising technique to determine oil content and quality traits of JCL seeds. It performed well to determine concentrations of oil, linoleic and oleic acids in JCL seed flour samples. Since NIRS allows simultaneous determination of different quality traits, it is a simple tool to reduce analytical time and cost and thus could be very helpful in analysis of a large number of samples in breeding programs and in industrial processing of the seeds and their by-products.

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