UTILIZATION OF DEFATTED *JATROPHA CURCAS* (PHYSIC NUT) SEED CAKE

MISS DONLAPORN SAETAE

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
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A Thesis Submitted in Partial Fulfillment of the Requirements for
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Abstract

Jatropha curcas is an economic important plant because of its several potential industrial and medicinal uses. Its seed cake, a by-product generated from oil extraction process of *J. curcas* seed, is rich in protein which could be used as an alternative protein source for the food or feed industries. However, the seed cake contains toxic agents, phorbol esters, and also anti-nutritional factors which are phytic acid, trypsin inhibitors, lectin and saponin. These toxin and anti-nutritional factors might not have only adverse effects, but could also provide some benefits for agricultural and food systems. The objectives of this study were to study an antifungal activity of phorbol esters extracted from the *J. curcas* seed cake, the functional properties of proteins isolated from the *J. curcas* seed cake and its detoxified seed cake, and formulate the starter broiler diets containing the seed cakes and protein isolates.

Phorbol esters were extracted from *J. curcas* seed cake to test their antifungal activity. The ethanolic extract containing phorbol esters showed antifungal activities against *Fusarium oxysporum*, *Pythium aphanidermatum*, *Lasiodiplodia theobromae*, *Curvularia lunata*, *Fusarium semitectum*, *Colletotrichum capsici*, and *Colletotrichum gloeosporioides*. The extract could therefore be used as an antifungal agent for agricultural applications.

Functional properties of proteins isolated from *J. curcas* seed cake and the seed cake detoxified by ethanol extraction were studied. The solubilities of both protein isolates were maximum and minimum at pHs of 12.0 and 4.0, respectively. The water binding capacity of protein isolated from the seed cake was 2-fold higher than that of protein isolated from the detoxified seed cake. The proteins from the seed cake and the detoxified seed cake provided the oil binding capacities of 1.86 and 1.07 ml oil/g protein, respectively. The foam capacities and stabilities including emulsion activities and stabilities of both protein isolates were high in a range of basic pHs. Their foam and emulsion stabilities decreased with increasing time. The results suggest that *J. curcas* seed cake has a potential to be exploited as a novel source of functional protein for food or feed applications.

The *J. curcas* seed cake, its detoxified seed cake and proteins isolated from both seed cakes were applied as protein sources in starter broiler diets prepared by extrusion at various temperatures. After the extrusion, the toxin and anti-nutritional factors in all diets decreased with increased extrusion temperatures. The phorbol ester contents were significantly reduced at 160°C, while the trypsin inhibitors were completely inactivated at 120°C. The saponins and phytic acids were completely removed in temperature ranges of 120-140°C and 140-160°C, respectively. Extrusion, therefore, was an effective method to detoxify toxin and anti-nutritional factors found in the diets containing *J. curcas* seed cake and its proteins.

In conclusion, *J. curcas* seed cake would be applied for a source of antifungal agent and a protein source of food and feed ingredients

Keywords : *Jatropha curcas* / Seed Cake / Phorbol Esters / Antifungal Agent / Protein / Functional Properties / Extrusion

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LIST OF SYMBOLS

a*	=	Color-opponent dimension: negative values indicate green and positive values indicate magenta.
b*	=	Color-opponent dimension: negative values indicate blue and positive values indicate yellow.
°C	=	Degree Celcius
L*	=	Lightness: L* = 0 yields black and L* = 100 indicates diffuse white.
R^2	=	R-squared (coefficient of determination)
o	=	Ortho-substitution
p	=	Para-subtitution
α	=	Alpha
β	=	Beta
Δ	=	Delta

LIST OF ABBREVIATIONS

µg	=	Microgram(s)
µl	=	Microliter(s)
µm	=	Micrometer(s)
Cys	=	Cysteine
cm	=	Centimeter(s)
DNA	=	Deoxyribonucleic acid
Ed.	=	Editor
Eds.	=	Editors
et al.	=	*et alia* (and other; Latin)
FAO	=	Food and Agriculture Organization
g	=	Gram(s) or relative centrifugal force (RCF)
HIV	=	Human Immunodeficiency Virus
HPLC	=	High-performance liquid chromatography or high-pressure liquid chromatography
h	=	Hour(s)
ID	=	Inner diameter
i.e.	=	*id est* (that is; Latin)
kcal	=	Kilocalorie(s)
kg	=	Kilogram(s)
kGy	=	Kilogray(s)
LD_{50}	=	Lethal dose 50, or median lethal dose
Ltd.	=	Limited company
l	=	Liter(s)
M	=	Molarity
ME	=	Metabolizable energy
mAU	=	Milli absorbance unit
mAU*s	=	Peak area
mM	=	Millimolar
m	=	Meter (s)
mg	=	Milligram(s)
min	=	Minute(s)

ml	=	Milliliter(s)
mm	=	Millimeter(s)
N	=	Normality
No.	=	Number
NRC	=	National Research Council
nm	=	Nanometer (s)
PDA	=	Photodiode array
Pty.	=	Proprietary limited company, a business structure under Australian and Southern African law
p.	=	Page
pH	=	Potential of hydrogen ion
pp.	=	Pages
ppm	=	Part(s) per million
rpm	=	Revolution(s) per minute
SD	=	Standard deviation
sec	=	Second(s)
v:v	=	Volume:volume
v/v	=	Volume/volume
WHO	=	World Health Organization
w/v	=	Weight/volume
w/w	=	Weight/weight