MERIT RESEARCH JOURNALS
www.meritresearchjournals.org

Merit Research Journal of Medicine and Medical Sciences (ISSN: 2354-323X) Vol. 4(8) pp. 384-391, August, 2016
Available online http://www.meritresearchjournals.org/mms/index.htm

Original Research Article

Influences of doum fruit (Hyphaene thebaica) extract on the reproductive parameters, blood picture, lipid profile and hepato-renal functions in rats

Aida E. Bayad

Veterinary Services Center, Faculty of Veterinary Medicine, Alexandria University, Egypt.

Email: aida_bayad@yahoo.com
Tel: +201002573202
Fax: +20452963526

Abstract

The fruits of doum have antimicrobial, antioxidant, hypolipidemic, antidiabetic and antihypertensive activities. This study investigated the efficacy of the decoction of doum fruits on the reproductive parameters, blood picture, lipid profile and hepato-renal functions in rats. Acute toxicity studies (LD_{50} values) were evaluated in rats. Single doses of the tested material were given orally and clinical signs, symptoms and mortality were recorded during 14- day observation period. The reproductive parameters (fertility index, sex ratio, no. of alive fetuses, no. of implantation, no. of resorption, weight at birth, the development and viability of first generation pups during the pre-weaning periods, and survival percent), blood picture [red blood corpuscles (RBCs), white blood corpuscles (WBCs), packed cell volume (PCV), hemoglobin concentration (Hb) and phagocytic activity] and hepato-renal functions were investigated in rats. The results showed that the decoction of doum fruits is well tolerated and no mortality or morbidity until the dose of 5 g/kg b. wt. Repeated oral administration of doum fruits at 0.5 g/kg b. wt. or 2 g/kg b. wt. was ineffective on the normal reproductive parameters. While, the RBCs, PCV, Hb and percent of phagocytic activity were significantly increased. A significant decrease in blood glucose, cholesterol, triglycerides and total lipid levels were observed after one and two months of administration of the decoction of doum fruits. The obtained results confirm the value of doum fruits as haematinic potentials, hypolipidemic, improve the hepato-renal functions and without side effects on the studied reproductive parameters. The doum fruit under test may be of value in treatment of various health problems, improve lipid profile, hepato-renal functions, confirming its haematinic potential and no side effects on the investigated reproductive parameters .

Keywords: Blood picture, Doum, Hepato-renal functions, Lipid profile, Rats, Reproduction

INTRODUCTION

Several plants that are reported to have beneficial effects against various ailments were later found to have harmful effects on health as reproduction (Mishra and Singh, 2008; Yakubu and Afolayan, 2009; Ainehchi and Zahedi, 2014). The toxic effects of most of the plants on reproduction were recognized while administering them for therapeutic use. Although a few plants have reached clinical trials, most of them failed the trails due to their toxicity.

Hyphaene thebaica belongs to the family Palmae and subfamily Borassoideae. This plant is commonly known as a doum palm. The tree is found in countries such as Egypt, Senegal, Sudan, Central Africa, Nigeria, Tanzania and Mauritania (Walter, 1971). *Hyphane thebaica* extracts are used in the treatment of ilharzias, haematuria, bleeding and also as a haematinic agent (Adaya *et al.,* 1977; Von Maydell, 1986; Kamis *et al.,* 2003). The fruits of doum showed antimicrobial, anti-

oxidant, hypolipidemic, antidiabetic and antihy-pertensive activities (Dosumu *el al.,* 2006; El-Gendy *et al.,* 2008; Abou-Elalla 2009; Eldahshan *et al.,* 2009; Shehu *et al.,* 2014; Abdel-moniem *et al.,* 2015). In a similar study using ethanolic extract of the plant, Kamis *et al.* (2000) reported that at high concentration, the plant is hypolipidemic, hepatotoxic and nephrotoxic. However, Modu *et al.* (2000/2001) using aqueous extract of *Hyphaene thebaica* found the extract to be hypolipidemic but nontoxic to both liver and kidney. A one study reported that the lower levels of doum improved spermatogenesis, and a higher levels induced a reverse effects (Hetta *et al.,* 2005) and there is no available any published study concerning the influence of doum fruits on reproduction. The aim of this study is to investigate the effect of the aqueous decoction of doum fruits on some reproductive parameters, lipid profile, hepato-renal functions in rats to establish safety or otherwise as well as its haematinic potentials.

MATERIALS AND METHODS

Animals

Adult male and female Wistar rats weighing 180 ± 10 g were used. The animals were obtained from a closed random bred colony at the Faculty of Veterinary Medicine, Alexandria University, Alexandria, Egypt. Animals were maintained on food and water ad libitum and housed in groups of six in isolated cages. The animals were acclimatized for 2 weeks prior to usage. The investigation conforms to the Guide for the Care and Use of Laboratory Animals published by US National Institutes of Health (NIH publication no. 85-23, revised 1996). The local ethics committee approved the study.

Preparation of the decoction of doum fruits

The fruit was cleaned, debris removed and then separated into pulp and seed. The pulp was dried and ground into fine powder. The decoction of doum fruits was made by boiling 10 g of the powdered pulp in 100 ml of distilled water for 2 min. (rich in water-soluble phenolic contents, Hsu *et al.,* 2006). Then filtered with Whatman filter paper no.1 and stored at 4°C. The filtrate was vigorously shaken to obtain a homogenous mixture before administration.

Experimental design

Acute toxicity studies

The study was carried out in rats. The animals were fasted overnight prior to the actual experimental procedure. Single graded doses of the decoction of doum fruits (from 0.1g to 5 g/kg b. wt.) and the vehicle were given orally by stomach tube to adult Wistar rats. Animals were observed for clinical signs, symptoms and mortality continuously for first 2 hrs and then for every four hrs upto 14 days. The LD_{50} values were calculated according to Finney's (1982).

Hematological, lipid profile and hepato-renal studies

Three groups each of 6 mature male albino wistar rats 180 ± 10 g were used. The decoction of doum fruits was given by stomach tube once daily for a period of 2 months at two dose levels 0.5 and 2 g/kg b. wt. (the dose is calculated as g/kg b.wt.). Meanwhile, rats of the control group were given only the vehicle (dist. water). Rats were fed with standard feed and provided with water ad libitum. After 2 weeks, 1 and 2 months from decoction of doum fruits administration, blood was collected from inner canthus of the eye under light ether anesthesia for hematological (RBCs, WBCs, PCV, Hb), (Schalm *et al.,* 1975), and percent of phagocytic activity (Hawk et al., 1965) and serum analysis [total protein, albumin, globulin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), urea, creatinine, glucose, triglycerides, total lipids and total cholesterol] were performed using commercial kits from Diamond Diagnostic, Egypt and using a UV spectrophotometer (Jenway, 6405 Model, Japan)..

Reproductive Studies

Segment I: Study of fertility

A fertility study was carried out using male and female albino wistar rats 180 ± 10 g. The decoction of doum fruits was given at the dose of 2 g/kg b. wt. once daily to males and females respectively for 35 and 14 days prior to mating. Dosed males and females were each mated with non-dosed counterparts. Dosed female rats were further treated throughout the gestation period. Control rats received the vehicle only. On day 20 of pregnancy the female rats were sacrificed and fetuses were delivered by caesarean section for further examinations including; fertility index, sex ratio, weight at birth (Faqi *et al.,* 1998). The number of *corpora lutae*, implantations, resorptions, and live and dead fetuses were recorded. Uteri with no visible implantations were stained with 10% ammonium sulfide (Kopf and Salewski, 1964) and examined for evidence of early resorptions.

Segment II: Peri - and postnatal study

In the peri- and postnatal study, 10 pregnant rats received the decoction of doum fruits at the dose 2 g/kg

Table 1. Hematological parameters of rats given decoction of doum fruits by gavage once daily for 2 months.

	Parameter				
	Hb (g/dl)	PCV%	RBCs X 10^6/Cmm	WBCs X 10^3/Cmm	Phagocytic activity%
Control (10 ml dist. water/kg)					
Pretreatment	10.7±0.12	38.0±0.11	6.0±0.22	7.3±0.22	21.0±0.71
2nd week	10.4±0.20	37.1±0.40	6.1±0.22	7.5±0.35	22.4±0.40
1st month	11.0±0.33	38.3±1.01	6.2±0.30	7.4±0.40	21.2±0.49
2nd month	10.6±0.31	37.4±1.24	6.2±0.41	7.5±0.32	22.1±0.50
Decoction of doum fruits (0.5 g/kg)					
Pretreatment	10.6±0.21	39.7±0.52	6.2±0.42	7.4±0.30	20.2±0.63
2nd week	11.2±0.23	40.2±1.02	5.9±0.31	7.3±0.40	24.4±0.51*
1st month	11.1±0.22	40.1±2.11	5.9±0.43	7.2±0.43	25.0±0.63*
2nd month	11.2±0.45	40.3±2.09	6.3±0.55	7.5±0.52	25.4±0.60*
Decoction of doum fruits (2 g/kg)					
Pretreatment	10.6±0.23	39.2±1.10	6.0±0.31	7.6±0.44	20.3±0.71
2nd week	11.2±0.11	40.5±1.12	6.1±0.57	7.3±0.43	25.8±0.37*
1st month	11.3±0.12	40.9±1.02	6.2±0.35	7.4±0.34	24.6±0.51*
2nd month	13.7±0.67*	43.2±0.98*	7.5±0.21*	7.3±0.52	25.8±0.14*

Significantly different compared to control (pretreated group), P< 0.05.
Values are means ± S.E. N. = 6 animals.

b. wt. once daily. Dosing was started from day 16 of gestation and continued throughout the 3 weeks lactation period. Ten other pregnant rats were used as controls. Observations on the offsprings were made at birth and at day 4, 14 and 21 after birth including; the development and viability of first generation pups during the pre-weaning periods, and survival percent (Faqi *et al.,* 1998).

Statistical analysis

The data were analyzed by ANOVA as described by Snedecor and Cochran (1980) and mean values of various treatments were compared with control values. Results are present as mean ± S.E. and considered the statistical analyses were performed with the software Graph Pad Prism, version 3 for windows, Graph Pad Software (San Diego, CA, USA) statistical significant if $p < 0.05$.

RESULTS

Acute toxicity studies

The acute oral LD_{50} in rats was more than 5 g/ kg b. wt. and no abnormal gross behavior effects were observed.

Hematological, lipid profile and hepato-renal studies

Daily administration of the higher levels of the decoction of doum fruits for 2 months induced a significant increase in RBCs, PCV and Hb in rats (table 1). Moreover, the phagocytic activity percent was significantly increased at all periods and both dose levels of the decoction of doum fruits administration (table 1). Administration of the decoction of doum fruits induced a significant increase in serum total protein at higher dose after 1 and 2 months, while, total globulin was significantly increased after 1 and 2 months at all dose levels (table 2). Administration of the decoction of doum fruits did not cause any abnormal liver and kidney functional or metabolic changes as demonstrated by serum biochemical analysis in rats. Interestingly, doum fruits at all doses induced a significant decrease in serum ALP and urea after 2 months (tables 3,4). Serum creatinine level was significantly decreased after administration of higher dose after 2 months in rats, while ALT was significantly decreased at higher dose after 1 and 2 months (tables 3,4). Seum glucose level was significantly decreased after 2 week, 1 and 2 months from giving a higher dose (table 5). Serum cholesterol levels were significantly decreased in rats given higher dose at all periods of the experiment, while, it significantly decreased after 1 and 2 months from giving a lower dose (table 5). Administration of the decoction of doum fruits induced a significant decrease in triglycerides and total lipids after 1 and 2 months at all doses in rats (table 5).

Reproductive studies

Segment I: Fertility study in rats

The repeated administration of doum fruits did not affect

Table 2. Serum protein profile of rats given decoction of doum fruits by gavage once daily for 2 months.

	Parameter		
	Protein (g/dl)	**Albumin (g/dl)**	**Globulin (g/dl)**
Control (10 ml dist. water/kg)			
Pretreatment	5.08±0.24	3.26±0.27	1.82±0.15
2nd week	5.12±0.12	3.2±0.14	1.92±0.08
1st month	5.2±0.22	3.28±0.18	1.92±0.08
2nd month	5.28±0.21	3.5±0.22	1.78±0.19
Decoction of doum fruits (0.5 g/kg)			
Pretreatment	5.24±0.22	3.34±0.25	1.9±0.07
2nd week	5.64±0.27	3.66±0.29	1.98±0.02
1st month	5.48±0.33	3.24±0.44	2.24±0.24*
2nd month	5.48±0.21	2.88±0.41	2. 6±0.24*
Decoction of doum fruits (2 g/kg)			
Pretreatment	5.22±0.21	3.36±0.27	1.86±0.15
2nd week	5.52±0.26	3.34±0.23	2.18±0.22
1st month	6.0±0.27*	3.0±0.27	3.00±0.31*
2nd month	5.7±0.37*	3.0±0.31	2.70±0.20*

*Significantly different compared to control (pretreated group), P< 0.05.
Values are means ± S.E. N. = 6 animals.

Table 3. Effect of administration of decoction of doum fruits once daily for 2 months on serum AST, ALT, and ALP in rats.

	Parameter		
	AST (U/L)	**ALT (U/L)**	**ALP (U/L)**
Control (10 ml dist. water/kg)			
Pretreatment	50.2±1.56	17.2±0.58	81.4±1.12
2nd week	49.4±2.36	16.6±0.98	83.0±1.52
1st month	47.8±2.71	16.6±0.92	82.4±1.60
2nd month	46.8±2.01	16. 6±0.46	81.2±1.85
Decoction of doum fruits (0.5 g/kg)			
Pretreatment	48.8±2.82	19.0±0.71	82.2±1.96
2nd week	48.0±0.44	18.0±0.71	80.6±2.16
1st month	46.4±2.71	17.4±0.68	76.2±2.44
2nd month	45.0±2.10	16.8±1.16	73.6±2.73*
Decoction of doum fruits (2 g/kg)			
Pretreatment	47.6±3.21	18.6±0.51	79.8±1.99
2nd week	45.6±3.06	17.4±0.60	79.2±1.46
1st month	44.6±2.93	16.0±0.71*	74.4±2.32
2nd month	44.6±2.93	16.0±0.71*	71.6±2.91*

*Significantly different compared to control (pretreated group), P< 0.05.
Values are means ± S.E. N. = 6 animals.

Table 4. Effect of administration of decoction of doum fruits by gavage once daily for 2 months on serum urea and creatinine in rats.

	Parameter	
	Urea (mg/dl)	**Creatinine (mg/dl)**
Control (10 ml dist. water/kg)		
Pretreatment	19.2±0.67	0.56±0.05
2nd week	19.8±1.07	0.58±0.07
1st month	19.4±1.75	0.56±0.05
2nd month	18.6±2.07	0.58±0.06
Decoction of doum fruits (0.5 g/kg)		
Pretreatment	20.6±0.93	0.60±0.05
2nd week	19.0±0.89	0.58±0.03
1st month	19.0±1.23	0.48±0.03
2nd month	17.2±1.07*	0.58±0.03
Decoction of doum fruits (2 g/kg)		
Pretreatment	17.8±1.28	0.6±0.07
2nd week	17.6±2.32	0.58±0.08
1st month	16.2±1.8	0.58±0.08
2nd month	15.6±0.93*	0.40±0.04*

*Significantly different compared to control (pretreated group), P< 0.05. Values are means ± S.E. N. = 6 animals.

Table 5. Effect of administration of decoction of doum fruits by gavage once daily for 2 months on serum Triglycerides, total lipids, cholesterol and glucose in rats.

	Parameter			
	Triglycerides (mg/dl)	**Total lipids(g/l)**	**Cholesterol (mg/dl)**	**Glucose (mg/dl)**
Control (10 ml dist. water/kg)				
Pretreatment	104.4±3.14	5.06±0.40	59.6±1.29	66.6±2.09
2nd week	100.8±5.13	5.1±0.39	59.8±1.59	65.2±1.16
1st month	100.0±7.26	5.0±0.47	60.6±1.29	66.2±1.93
2nd month	101.0±6.8	5.06±0.37	56.8±2.78	63.0±3.04
Decoction of doum fruits (0.5 g/kg)				
Pretreatment	104.0±8.74	5.02±0.34	61.4±2.75	62.6±2.36
2nd week	98.8±7.12	4.88±0.39	57.4±1.89	59.0±2.12
1st month	95.4±7.24*	3.84±0.25*	51.8±1.07*	58.8±2.25
2nd month	91.6±4.31*	3.7±0.43*	49.2±1.07*	57.6±2.62
Decoction of doum fruits (2 g/kg)				
Pretreatment	105.0±7.26	4.78±0.51	60.8±1.65	64.4±2.02
2nd week	99.0±6.98	4.5±0.31	53.8±2.54*	56.4±2.06*
1st month	94.0±5.8*	3.74±0.23*	51.0±1.52*	57.2±2.96*
2nd month	81.0±3.68*	3.54±0.41*	49.6±1.03*	55.6±2.38*

*Significantly different compared to control (pretreated group), P< 0.05. Values are means ± S.E. N. = 6 animals.

the studied reproductive parameters (fertility index, no. of alive fetuses, no. of implantation, no. of resorption, weight at birth) as shown in table 6. Dosed males showed comparable data with the controls when dosed at 2 g/kg (table 6).

Segment II: Peri-and postnatal study

The repeated administration of doum fruits did not cause any deleterious effects on the dosed females and their offspring, the development and viability of first generation

Table 6. Effect of the administration of decoction of doum fruits given by gavage on fertility in rats.

Adult rat data	Dosage group (g/kg)			
	Control (10 ml dist. water/kg)		Decoction of doum fruits (2 g/kg)	
	C-M + T-F	T-M + C-F	C-M + T-F	T-M + C-F
No. of treated males	0	10	0	10
No. of treated females	10	0	10	0
No. of pregnant rats	7	7	8	8
No. of surviving females	10	10	10	10
Fertility index*	70	70	80	80
Litter data				
Average no. of implantations / no. of pregnancies	6.71	6.9	6.75	6.5
No. of alive fetuses	6.43	6.57	5.88	6.25
No. of resorbed fetuses	4.17	4.05	3.7	3.84
Average weight at birth (g)	5.23	5.08	5.09	5.32

C = Control, M = Male, T = Treated, F = Female
*Fertility index = No. of pregnant rats / No. of surviving females x 100

Table 7. Effect of the administration of decoction of doum fruits by gavage on the development and viability of first generation (F1) pups during the pre-weaning period in rats.

	Dosage group (g/kg)	
	Control (10 ml dist. water/kg)	Decoction of doum fruits (2 g/kg)
Mean number of pups/Litter.		
Born	6. 2±0.37	6.6±0.51
Born alive	5.8±0.30	6.2±0.30
Sex ratio (males)	49.4±1.07	49.2±1.02
Mean pup weight (g)/litter.		
Postnatal day O (PND) males	5.14±0.29	4.88±0.33
Females	4.98±0.06	4.84±0.09
PND 4 males	7.92±0.11	7.74±0.16
Females	7.62±0.16	7.46±0.31
PND 14 males	15.34±0.55	15.7±0.43
Females	14.5±0.48	14.2±0.73
PND 21 males	25.6±0.75	26.0±0.54
Females	23.8±1.24	24.2±1.24
Survival % *	100	100

Values are mean ± S.E. N. = 10 animals
*Survival % = No. of pups alive on PND 21 / No. of pups born on PND 0 x 100

pups during the pre-weaning periods, and survival percent, litter size, sex ratio and weight gain compared with the control (table 7).

DISCUSSION

Doum is one of commonly consumed beverages in traditional places in Egypt and is rich in polyphenolic compounds (Sharaf *et al.,* 1972). The beneficial effects of doum fruits have been studied by many authors. Their studies revealed that the aqueous extracts is a potent hypotensive, hypolipidemic, hypocholesterolemic, anti-diabetic, and antioxidant potential (El-Gendy *et al.,* 2008; Abou- Elalla 2009; Eldahshan *et al.* 2009; Shehu *et al.,* 2014; Abdel-moniem *et al.,* 2015). In the present study,

acute and long-term safety of the decoction of doum fruits was evaluated. Acute toxicity studies of the decoction of doum fruits indicated safety margin that is sufficiently wide to exclude the occurrence of toxic and lethal effects during clinical use even with relative overdosing.

Administration of the decoction of doum fruits in rats for 2 weeks, 1 and 2 months revealed a beneficial effect on the hemopoietic system, as indicated from the significant increase in Hb, PCV and RBCs count. The phagocytic activity percent was significantly improved in rat blood given the decoction of doum fruits at all periods of the experiment. At the same direction, Kamis *et al.* (2003) reported a significant increase in Hb concentration, PCV and RBCs count after doum extract administration.

In addition, it had no harmful effects on liver and kidney function tests as it improves serum levels of AST, ALT, ALP, urea and creatinine. The increase in serum protein and globulin might be due to the improvement of liver functions. In a similar study using ethanolic extract of the plant, *Kamis et al. (2000)* found that at high concentration, the plant is hypolipidemic, hepatotoxic and nephrotoxic. However, Modu *et al.* (2000/2001) using aqueous pulp extract of *hyphaene thebaica* found that the extract was hypolipidemic but nontoxic to both liver and kidney. This difference in response might be due to the differences in type of the doum extract or their dosages.

Repeated oral administration of the aqueous extracts of doum fruits in rats for 1 and 2 months significantly decreased total cholesterol, total lipids and triglycerides. This is advantageous for the treatment of hypercholesterolemia especially among Egyptians where low high–density lipoprotein (HDL-C) is the prevalent lipoprotein abnormality. High levels of total cholesterol and, more importantly, low– density lipoprotein (LDL-C) are major coronary risk factors (Temme *et al.,* 2002). El-Hazmi and Warsy (2001) showed that triglycerides were independently related to coronary heart disease and most of the antihypercholesterolemic drugs did not decrease triglycerides levels, but the aqueous extracts of doum fruits lower it significantly. This effect may be related to the increase in endothelium bound lipoprotein lipase which hydrolyzes the triglycerides into fatty acids. Previously authors reported that, the hypolipidemic properties of the aqueous pulp suspension of doum could be partly due to the presence of glycosides (Modu *et al*., 2000). Saponins have been reported to form complexes with cholesterol and bile in the intestine thereby indirectly reducing the cholesterol level in the blood (Milgate and Robert, 1995). This result is consistent with earlier report by Modu *et al.* (2000-2001) and Kamis *et al.* (2000) where aqueous and methanolic extracts were used respectively. Treatments that lower blood lipid especially cholesterol levels have been reported to prevent myocardial infarction and cerebrovascular accidents (Lansky, 1993).

The administration of aqueous extracts of doum fruits significantly decreased blood glucose levels after 1 and 2 months. This is inconsistent with earlier reports by Abdou *et al.* (2011) and Abdel-moniem *et al.* (2015). The pathogenesis of diabetes mellitus and the possibility of its management by oral administration of hypoglycemic agents have been extensively studied.

Studies on reproductive system revealed no significant toxic effects on fertility (fertility index, sex ratio, no. of alive fetuses, no. of implantation, no. of resorption, weight at birth, the development and viability of first generation pups during the pre-weaning periods, and survival percent) at all periods of the experiment. Also, Salib *et al.* (2013) reported that the treatment of alloxan-diabetic rats with doum extract resulted in highly significant increase in serum testosterone level and marked modulation in the level of both total acid phosphatase and prostatic acid phosphatase activities. On the contrary, in another study it was observed that a small dose improve spermatogenesis and a large dose impaired spermatogenesis (Hetta *et al.,* 2005). Moreover, several plants and plant products are reported to impede reproductive processes in many different animal species (Nordeng and Havnen 2004; Mortazavian *et al.,* 2012; Ainehchi and Zahedi, 2014). A great attention should be taken when an herbal product is used during pregnancy. Unfortunately, unlike those synthetic drugs not recommended for use in pregnancy because of known unwanted effects, there are insufficient data about undesirable maternal and perinatal consequences of use of herbal agents. Until date, there is no report on safety of doum fruit.

Previous studies on Doum had focused on the fruit due to its nutritional value, a hot water infusion of the dried fruit pulp is widely consumed as a health tonic. Research on the fruit pulp of *H. thebaica* showed that it contains nutritional trace minerals, proteins and fatty acids, in particular the nutritionally essential linoleic acid (Kamis *et al.,* 2003). The fruit contains significant amounts of saponins, coumarins, hydroxycinnamates, essential oils and flavonoids. The fruit also lowers blood pressure in animal models (Sharaf *et al.,* 1972). The aqueous extract of doum fruits showed an antioxidant activity; this is due to the substantial amount of their water-soluble phenolic contents (Hsu *et al.,* 2006). It could be concluded that, the doum fruit under test may be of value in treatment of various health problems, improve lipid profile, hepato-renal functions, confirming its haematinic potential and no side effects on the investigated reproductive parameters (fertility index, sex ratio, no. of alive fetuses, no. of implantation, no. of resorption, weight at birth, the development and viability of first generation pups during the pre-weaning periods, and survival percent).

CONCLUSION

The doum fruit administration at 0.5 g/kg b. wt. or 2 g/kg b. wt. has no side effects on the investigated reproductive parameters (fertility index, sex ratio, no. of alive fetuses, no. of implantation, no. of resorption, weight at birth, development and viability of 1st generation pups through the pre-weaning periods, and survival percent), improve lipid profile (serum triglycerides, total lipids, cholesterol), hepato-renal functions (serum AST, ALT, ALP, urea and creatinine, protein profile) confirming its haematinic potential (on RBCs, WBCs, Hb, PCV and phagocytic activity).

Conflict of Interest

The authors have declared that there is no conflict of interest related to this paper.

REFERENCES

Abdel-moniem M, Mustafa HN, Megahed HA, Agaibyi MH, Hegazy GA, El-Dabaa MA (2015). The ameliorative potential of Hyphaene thebaica on streptozotocin-induced diabetic nephropathy. Folia Morphol. 74 (4):447- 457.

Abdou HS, Sherifa H, Abd El Raouf SA, Abdel-Rahim EA (2011). Chromosomal aberrations and nucleic acids systems affected by some Egyptian medicinal plants used in treating female pregnant diabetic rats. American J Mol Biol. 1: 26-32.

Abou –Elalla FM (2009). Antioxidant and anticancer activities of doum fruit extract (Hyphaene thebaica). Af J Pure and Appl Chem. 3(10): 197-201.

Adaya AL, Bdliya H, Bitrus H, Fanjaji M, Eaton D, Gambo MB, Goggobe M, Makinta A, Okoli D, Omoluabi AD, Polet G, Salisu M, Sanus SS, Sac MT, Shuaib M (1977). Hidden Harvest Project in Research Series, vol. 3 No. 3. Compiled by 11ED and HNNCP; pp 14-27, 47-53.

Ainehchi N, Zahedi A (2014). Effects of Artemisia lanata Extract on Reproductive Parameters of Female Rats. Crescent J Med & Biol Sci. 1 (2): 49-53.

Dosumu OO, Nwosu FO, Nwogu CD (2006). Antimicrobial studies and phytochemical screening of extracts of *Hyphaene thebaica* (Linn) Mart fruits. Intl. J. Trop. Med. 1(4): 186-189.

Eldahshan O, Ayoub N, Singab A, Al-Azizi M (2009). Potential antioxidant phenolic metabolites from doum palm leaves. Afr J Pharmacy Pharmacol. 3 (4): 158-164.

El-Gendy A, El-Mileegy E, Ghyaty H, Malek A, El-Hamid M. (2008). The beneficial Dietary Hypotensive and Hypolipidaemic Effects of Hyphaene Thebaica (Doum). The Int. J. Alternative Med. 7 (1) : 1-9.

El-Hazmi MA, Warsy AS (2001). Evaluation of serum cholesterol and triglyceride levels in 1-6-year-old Saudi children. J Trop Pediatr. 47 (3):181-185.

Faqi AS, Dalsenter PR, Merker HJ, Chahoud I (1998). Reproductive Toxicity and Tissue Concentrations of Low Doses of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin in Male Offspring Rats Exposed Throughout Pregnancy and Lactation. Toxicol Appl Pharmacol. 150: 383-392.

Finney's DJ (1982). Probit Analysis. Cambridge, England, Cambridge Univ. Press, 236.

Hawk PB, Oscar BL, Summerson W (1965). Hawk's Physiological Chemistry, 14th edn. J and A Churchill Ltd: London.

Hetta MH, Yassin NZ, El Shaer MA (2005). Effect of Hyphaene thebaica on the spermatogenesis of male rats. Egypt Med J N R C. 4 (3): 35-39.

Hsu B, Coupar IM, Ng K (2006). Antioxidant activity of hot water extract from the fruit of the Doum palm, *Hyphaene thebaica*. Food Chem. 98: 317–328.

Kamis A B, Modu S, Markus PY (2000). Some biochemical effects of various doses of Ethanolic pulp extract of *Hyphaene thebaica*. Nig J expt App Biol. 1:33 – 36.

Kamis AB, Modu S, Zanna H, Oniyangi TA (2003). Preliminary biochemical and haematological effects of aqueous suspension of pulp of hyphaene thebaica in rats. Biokemistri. 13: 1-7.

Kopf R, Salewski SD (1964). Experimental and clinical chemoteratogenesis. Adv. Pharmacol. 247:121–135.

Lansky RS (1993). Plant that lower cholesterol. Acta Horticum. 2: 332-336.

Milgate J, Robert DCK (1995).The nutritional and biological significance of saponins. Nutri Res. 15: 1225 – 1249.

Mishra RK, Singh SK (2008). Safety assessment of *Syzygium aromaticum* flower bud (clove) extract with respect to testicular function in mice. Food Chem Toxicol. 46:33–38.

Modu S, Kamis AB, Markus PY (2000-01). Some biochemical effects on aqueous pulp extract of hyphaene thebaica (L) mart determination in rats. J Life Environ Sci. 2/3:139 – 143.

Modu S, Kamis AB, Usman MJ (2000). In vitro haemolytic activities of *hyphaene thebaica* (L) mart on human erythrocytes. Nig J Expt Biol. 1 : 32-37.

Mortazavian SM, Ghorbani A, Ghorbani Hesari T (2012). Effect of hydro-alcoholic extract of Viola tricolor and its fractions on proliferation of uterine cervix carcinoma cells. Iranian J Obstetrics Gynecol Infertil. 15: 9-16.

Nordeng H, Havnen GC (2004). Use of herbal drugs in pregnancy: a survey among 400 Norwegian women. Pharmacoepidemiol Drug Saf. 13: 371-380.

Salib YJ, Michael HN, Eskande EF (2013). Anti-diabetic properties of flavonoid compounds isolated from *Hyphaene thebaica* epicarp on alloxan induced diabetic rats. Pharmacognosy Res. 5 (1): 22–29.

Schalm OW, Jain NC, Carro EJ (1975). Veterinary haematology (3rd edition). Lea and Febiger, Philadelphia pp. 498 – 512.

Sharaf A, Sorour A, Gomaa N, Youssef M (1972). Some pharmacological studies on *Hyphaene thebaica* Mart. fruit. Qualitas Plantarum, 22 (1): 83–90.

Shehu B, Gidado A, Buratai L (2014). Hypoglycaemic, hypolipidaemic and possible toxicity of the methanolic fruit pulp extract of hyphane thebaica (L) Mart in alloxan¬-induced diabetic rats. J Med Applied Bioscien. 6: 1–10.

Snedecor GW, Cochran WG (1980). Statistical Methods, 6TH Ed.Iwoa State Univ. Press, Amess USA.

Temme EHM, Van Hoydonck PGA, Schouten GE, Kesteloot H (2002). Effects of a plant sterol-enriched spread on serum lipids and lipoproteins in mildly hypercholesterolaemic subjects . Acta Cardiol. 57 (2): 111-115.

Von Maydell H (1986). Trees and Shrubs of Sahel, their characteristics and uses. Eschborn, Germany. p.173 – 175.

Walter H (1971). General features of vegetables of Sub-Tropical and tropical regions. In Ecology of tropical and sub-tropical vegetable. Oliver and Boyd, Edinburgh pp. 226-298.

Yakubu M T, Afolayan AJ (2009). Reproductive toxicologic evaluations of Bulbine natalensis Baker stem extract in albino rats. Theriogenol. 72: 322–332.