Toxicity Evaluation of Sappan Wood Extract in Rats

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Background: *The heartwood of Caesalpinia sappan L. or sappan wood has long been used in folk medicines to treat tuberculosis, diarrhea, dysentery, skin infections and anemia.*
Objective: *To study the acute and subacute toxicities of sappan wood extract in rats.*
Material and Method: *For studying acute toxicity, a single oral dose of 5,000 mg/kg of sappan wood was administered to rats. Subacute toxicity was studied by the daily oral administration of the extract at the doses of 250, 500 and 1,000 mg/kg body weight for consecutive 30 days.*
Results: *The extract of sappan wood (5,000 mg/kg) showed no toxicity in terms of general behavior change, mortality, or change in gross appearance of internal organs. Subacute toxicity study showed no abnormalities in treatment groups as compared to the controls. Body and organ weights, hematological, blood chemical, necropsy, and histopathological parameter of all groups were similar.*
Conclusion: *Sappan wood extract did not produce any acute or subacute toxicity in both female and male rats.*

Keywords: *Sappan wood extract, Acute toxicity, Subacute toxicity*

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Caesalpinia sappan L. is a plant of Leguminosae family, locally known as "Sappan". Sappan wood is pale red in color, hard and heavy with even and fine texture. A decoction of the heartwood is traditionally used as natural coloring agent in beverage, food, garment and cosmetics. The decoction, medicinally recommended as a substitute for logwood, is reputed as effective emmenagogue and strong astringent[1-3]. It has been previously used in cases of acute diarrhea, dysentery and haemorrhage, especially from the lungs. Commonly, it is given as a tonic to women after confinement, and also considered useful in some forms of skin diseases as well as used as diuretic. In addition, the roots, stems, and seeds of the plant are used as sedatives and vulnerary[4].

Pharmacological importance of Sappan have been reported as hepatoprotective[5], anticonvulsant[6], anti-inflammatory, antibacterial[7], and antioxidant[8,9].

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Despite long record of usage for various purposes, little information on Sappan toxicity is available. The present study was aimed for exploring acute and subacute toxicity of Sappan extract in rats.

Material and Method

Plant materials

Sappan wood was purchased from Vejapong Osoth retail shop in Bangkok and identified at the Department of Pharmaceutical Botany (Rungravi Temsiririrkkul), Faculty of Pharmacy, Mahidol University.

Extraction method

One kilogram of Sappan heartwood was cut into small pieces and boiled with 10 liters of water for 30 minutes. After filtration, the marc was subsequently boiled following same procedure for 3 times, until exhausted. The filtrates were combined and concentrated further. The concentrate was then dried using lyophilizer. The dry powder extract was kept in a closed container.

Experimental animals

Male and female Wistar rats, weighing within 180-250 g were obtained from the National Laboratory Animal Center, Nakorn Pathom, Thailand. Animals were randomly assigned to control and treatment groups. They were housed under standard environmental conditions of 25 $\pm$ 1°C, under a 12 h dark-light cycle, and were allowed free access to drinking water and standard pellet diet. Rats were kept in experimental facility for 1 week to allow them to be acclimated prior to dosing. The Animal Ethics Committee of Faculty of Medicine, Thammasat University, Pathumthani, Thailand, approved all experimental protocols (No. 0005/2003).

Acute toxicity

Acute toxicity test was performed according to the World Health Organization (WHO) guideline[10] and the Organization of Economic Co-operation and Development (OECD) guideline for testing of chemicals TG420[11]. Five rats per sex were administrated a single oral dose of 5,000 mg/kg body weight while the control group received water vehicle. Body weight, signs of toxicity and mortality were observed after the administration at the first, second, fourth and sixth hour and once daily for next 14 days. On the 15th day, all rats were kept fasted for 16-18 hours, and then sacrificed for necropsy examination. The internal organs were excised and weighed. The gross pathological observations of the tissues were performed.

Subacute toxicity

According to WHO guideline[10] and the OECD TG407[12], rats were divided into 5 groups of 20 animals (10 male and 10 female). The extract was administered orally at concentrations of 250, 500 and 1,000 mg/ml in 40% glycerine to the three subsequent treatment groups for consecutive 30 days, while the two control groups received distilled water and 40% glycerine, respectively. Signs of toxicity, mortality and body weight changes were monitored daily.

At the end of the experiment, all animals were kept fasted for 16-18 h and then anesthetized with intraperitoneal injection of pentobarbital sodium at a dose of 50 mg/kg on the 31st day. Blood samples for hematological and blood chemical analyses were taken from common carotid artery. All rats were sacrificed after the blood collection. The internal organs and some tissues were weighed to determine relative organs' weights and observed for gross lesions. All tissues were preserved in 10% neutral buffered formaldehyde solution for histopathological examination.

Statistical analysis

Results were expressed as mean $\pm$ standard error of mean (SEM). Statistical significance was determined by one-way analysis of variance (ANOVA) and post hoc least-significant difference (LSD) test. P-values less than 0.05 were considered significant.

Results and Discussion

Both female and male rats administered with the Sappan wood extract at a dose of 5,000 mg/kg did not show any toxic signs and symptoms during the experimentation period. Neither body weight nor internal organs' weight of treatment rats was changed significantly relative to that of control. The internal organs of treatment rats such as brain, lung, heart, liver, spleen, pancreas, adrenal gland, kidney, and sex organ showed no pathological abnormality relative to these organs of the control (data considered not necessary to be included). This suggests that Sappan wood extract is practically not toxic through acute exposure in rats.

The subacute oral administration of Sappan wood extract (250, 500 and 1,000 mg/kg) resulted neither changes in general behavior nor in the health condition during the experimentation period. Body weight of all treatment groups normally increased in similar to that of the control (Fig. 1). In case of 1,000 mg/kg dose,

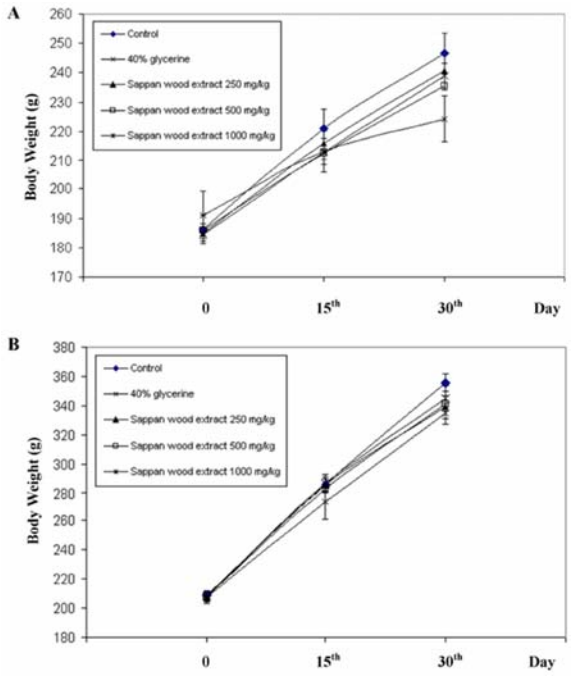

Fig. 1 Body weights of female (A) or male (B) under subacute doses of Sappan wood extract

body weight gain in treatment rats decreased (Table 1). Both female and male rats were healthy as shown by the normal appearance of general behavior, respiratory pattern, cardiovascular signs, motor activities, reflexes, and normal change in skin and fur. Consequently, the affected body weight and body weight gain may have resulted from physiological change in rats such as decrease or increase in food intake and metabolic state. The internal organ weights of the treatment and the control rats were not different in both gross and microscopic examination (Table 2). The observed changes are attributable to usual adjustment in food intake or metabolism. Furthermore, no morbidity or disease was observed during the entire experimentation period.

In hematological examination, significant increase in platelet counts in the female treatment rats was observed for 1,000 mg/kg/day dose (Table 3). Table 4 lists the differential white blood cell counts. The differential white blood cell counts of female treatment rats (in 250 and 1,000 mg/kg doses) were significantly different from those of the female control. However, these values were still within the normal range[13,14].

As listed in Tables 5 and 6, significant

Table 1. Body weights of rats under subacute doses of Sappan wood extract

	Body weight (g)			
	Day 0	Day 15th	Day 30th	Weight gain on 30th day
Female				
Control	186.20 ± 4.77	221.00 ± 6.77	246.60 ± 6.93	60.40 ± 3.78
40% glycerine	184.40 ± 2.29	213.00 ± 4.69	239.00 ± 4.38	54.20 ± 3.16
Sappan wood extract 250 mg/kg	184.80 ± 3.32	216.00 ± 5.60	240.80 ± 6.52	54.60 ± 4.69
Sappan wood extract 500 mg/kg	186.00 ± 3.18	212.60 ± 7.54	235.60 ± 8.85	49.60 ± 7.62
Sappan wood extract 1,000 mg/kg	191.10 ± 8.06	213.10 ± 7.26	224.30 ± 7.76*	33.14 ± 10.33*
Male				
Control	208.80 ± 2.73	285.80 ± 4.15	355.60 ± 5.92	141.40 ± 7.18
40% glycerine	208.20 ± 3.35	286.60 ± 6.19	344.80 ± 8.81	136.60 ± 7.29
Sappan wood extract 250 mg/kg	207.40 ± 2.76	285.40 ± 5.46	339.00 ± 7.62	131.80 ± 6.75
Sappan wood extract 500 mg/kg	208.20 ± 2.47	282.80 ± 5.12	341.40 ± 5.43	133.20 ± 4.46
Sappan wood extract 1,000 mg/kg	207.60 ± 4.44	273.40 ± 12.28	334.60 ± 7.36*	127.00 ± 5.80

Values are expressed as mean ± SEM, n = 10, * Significantly different from control, $p < 0.05$

Table 2. Organ weights of rats under subacute doses of Sappan wood extract

	Control	40% glycerine	Sappan wood extract		
			250 mg/kg	500 mg/kg	1,000 mg/kg
Female					
Lung	1.20 ± 0.05	1.18 ± 0.02	1.19 ± 0.06	1.23 ± 0.03	1.15 ± 0.06
Heart	0.83 ± 0.04	0.82 ± 0.03	0.81 ± 0.02	0.87 ± 0.06	0.81 ± 0.01
Liver	6.55 ± 0.27	6.61 ± 0.14	6.57 ± 0.19	6.98 ± 0.34	6.21 ± 0.23
Pancreas	0.82 ± 0.05	0.88 ± 0.09	0.89 ± 0.09	0.83 ± 0.14	0.81 ± 0.13
Spleen	0.59 ± 0.02	0.67 ± 0.09	0.58 ± 0.02	0.61 ± 0.04	0.55 ± 0.04
Adrenal	0.05 ± 0.00	0.04 ± 0.00	0.05 ± 0.00	0.05 ± 0.00	0.05 ± 0.00
Kidney	0.78 ± 0.02	0.79 ± 0.02	0.77 ± 0.02	0.78 ± 0.02	0.76 ± 0.02
Ovary	0.08 ± 0.00	0.07 ± 0.00	0.07 ± 0.00	0.08 ± 0.00	0.07 ± 0.00
Brain	0.49 ± 0.05	0.41 ± 0.03	0.39 ± 0.03	0.48 ± 0.05	0.42 ± 0.06
Male					
Lung	1.43 ± 0.07	1.45 ± 0.03	1.45 ± 0.04	1.49 ± 0.06	1.40 ± 0.03
Heart	1.08 ± 0.04	1.01 ± 0.03	1.05 ± 0.03	1.02 ± 0.02	1.07 ± 0.04
Liver	10.02 ± 0.29	9.62 ± 0.29	9.87 ± 0.39	9.53 ± 0.44	8.87 ± 0.37
Pancreas	0.82 ± 0.06	0.83 ± 0.06	0.79 ± 0.09	0.84 ± 0.06	0.79 ± 0.05
Spleen	0.64 ± 0.03	0.68 ± 0.03	0.78 ± 0.02	0.70 ± 0.04	0.68 ± 0.04
Adrenal	0.05 ± 0.00	0.04 ± 0.00	0.05 ± 0.00	0.05 ± 0.00	0.05 ± 0.00
Kidney	1.04 ± 0.03	0.96 ± 0.01	1.02 ± 0.02	1.00 ± 0.03	0.98 ± 0.02
Testis	1.80 ± 0.05	1.75 ± 0.02	1.87 ± 0.03	1.81 ± 0.07	1.79 ± 0.05
Epididymis	0.61 ± 0.02	0.69 ± 0.05	0.64 ± 0.02	0.61 ± 0.02	0.59 ± 0.02
Brain	1.92 ± 0.03	1.87 ± 0.05	1.87 ± 0.05	1.86 ± 0.03	1.87 ± 0.02

Values are expressed as mean ± SEM, n = 10, * Significantly different from control, $p < 0.05$

differences among the experimental groups are evident in many parameters: blood urea nitrogen (BUN), total protein, serum glutamic-oxaloacetic transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT), and alkaline phosphatase (ALP). Nevertheless, these significant values fell within the normal ranges[15-17]. In general, if the clinical blood chemistry values differ more or less than one fold from the normal values, abnormality of pancreas, kidney, and liver function should be noted[14,15]. Acute or chronic renal failure is the most common cause of an elevated BUN. However, there are many factors besides renal disease that can cause BUN alterations, including protein breakdown, hydration status, and liver failure[17,18]. Total protein measurement can reflect nutritional status and may be useful for screening and diagnosis of kidney disease, liver disease, and many other conditions. High total protein levels may also occur with chronic inflammation or infections and dehydration. Low total protein levels suggest a liver disorder, a kidney disorder, or a disorder in which protein is not digested or absorbed properly. Moreover, dietary insufficiency, malnutrition, or malabsorption can cause severely depleted level of serum proteins, primarily albumin[19]. The blood SGOT levels are thus elevated with liver damage (viral hepatitis) or with an insult to the heart (heart attack). In clinical practice, SGOT determinations are used to evaluate myocardial injury and to diagnose and assess the prognosis of liver disease resulting from hepatocellular injury[17,18]. SGPT was another parameter monitored. This enzyme is essentially found in the same tissues that have high concentrations of SGOT. Although serum concentrations of both SGOT and SGPT increase whenever disease processes affect liver cell structure, the SGPT is a more liver-specific enzyme. ALP test is done to diagnose liver or bone disease. The higher than normal levels of ALP may be due to bone disease, hepatitis, liver disease, and anemia. Moreover, the lower than normal levels may be due to hepatitis, cirrhosis, and protein deficiency[17,18]. Normally, the increased level of those parameters more than one fold would then be highly significant for clinical pathology with abnormalities in physical appearances. In this study, significant decreases and increases in

Table 3. Hematological examinations of female and male rats under subacute doses of Sappan wood extract

Group	Dose (mg/kg)	Red blood cell ($x10^6$/ml)	Hemoglobin (g/dl)	Hematocrit (%)	MCV (fl)	MCH (pg)	MCHC ($x10^5$/ml)	Platelet (g/dl)
Female								
Control	-	7.18 ± 0.15	15.89 ± 0.22	44.00 ± 0.93	61.42 ± 0.60	22.18 ± 0.26	36.09 ± 0.52	7.36 ± 0.33
40% glycerine	-	6.78 ± 0.29	14.96 ± 0.44	41.90 ± 1.02	62.39 ± 1.91	22.24 ± 0.52	36.20 ± 0.50	8.06 ± 0.29
Sappan wood	250	7.14 ± 0.10	15.65 ± 0.22	43.70 ± 0.77	61.09 ± 0.59	21.91 ± 0.14	35.92 ± 0.33	7.64 ± 0.25
extract	500	7.35 ± 016	15.64 ± 0.43	44.80 ± 1.00	61.06 ± 0.48	21.29 ± 0.48	34.89 ± 0.87	7.64 ± 0.27
	1,000	7.49 ± 0.19	16.41 ± 0.41	46.00 ± 1.34	61.53 ± 0.90	21.93 ± 0.30	35.66 ± 0.41	8.45 ± 0.29*
Male								
Control	-	7.73 ± 0.08	16.50 ± 0.16	47.90 ± 0.69	61.60 ± 0.62	21.36 ± 0.12	34.68 ± 0.28	7.07 ± 0.23
40% glycerine	-	7.71 ± 0.13	16.45 ± 0.24	47.60 ± 0.85	61.56 ± 0.49	21.36 ± 0.22	34.67 ± 0.27	7.14 ± 0.34
Sappan wood	250	7.78 ± 0.11	16.59 ± 0.23	48.30 ± 0.79	61.73 ± 0.79	21.31 ± 0.21	34.57 ± 0.24	6.61 ± 0.25
extract	500	7.68 ± 0.20	16.49 ± 0.29	47.60 ± 1.03	61.65 ± 0.74	21.53 ± 0.25	34.93 ± 0.43	7.35 ± 0.46
	1,000	7.31 ± 0.47	15.63 ± 1.18	46.20 ± 2.88	62.85 ± 0.57	21.07 ± 0.65	33.55 ± 0.95	6.43 ± 0.31

Values are expressed as mean ± SEM, n = 10, * Significantly different from control, $p < 0.05$

Table 4. Differential white blood cell counts of rats under subacute doses of Sappan wood extract

Group	Dose (mg/kg)	White blood cell ($x10^3$/ml)	Neutrophil (%)	Lymphocyte (%)	Monocyte (%)	Eosinophil (%)	Basophil (%)
Female							
Control	-	2.65 ± 0.33	16.20 ± 1.42	74.60 ± 1.03	8.10 ± 0.23	1.10 ± 0.28	0.00 ± 0.00
40% glycerine	-	2.25 ± 0.23	14.70 ± 1.05	75.40 ± 0.92	7.70 ± 0.37	2.20 ± 0.59	0.00 ± 0.00
Sappan wood	250	2.91 ± 0.34	21.00 ± 0.71*	69.30 ± 2.25*	7.30 ± 0.47	2.40 ± 0.27*	0.00 ± 0.00
extract	500	3.28 ± 0.36	16.80 ± 1.26	73.50 ± 1.67	7.90 ± 0.23	2.20 ± 0.36	0.00 ± 0.00
	1,000	4.16 ± 0.66	21.00 ± 2.03*	70.00 ± 2.37	8.00 ± 0.22	1.00 ± 0.44	0.00 ± 0.00
Male							
Control	-	3.22 ± 0.31	23.30 ± 1.73	69.10 ± 1.41	7.00 ± 0.65	0.60 ± 0.34	0.00 ± 0.00
40% glycerine	-	3.60 ± 0.27	23.10 ± 0.98	68.50 ± 0.98	7.60 ± 0.37	0.80 ± 0.25	0.00 ± 0.00
Sappan wood	250	4.50 ± 0.19	23.10 ± 1.19	68.40 ± 1.21	8.00 ± 1.25	0.50 ± 0.27	0.00 ± 0.00
extract	500	4.52 ± 0.34	23.20 ± 1.85	70.90 ± 1.70	6.20 ± 0.83	0.90 ± 0.28	0.00 ± 0.00
	1,000	3.86 ± 0.43	25.00 ± 2.30	67.20 ± 1.58	6.50 ± 0.83	1.30 ± 0.33	0.00 ± 0.00

Values are expressed as mean ± SEM, n = 10, * Significantly different from control, $p < 0.05$

Table 5. Clinical blood chemistry examinations of female rats under subacute doses of of Sappan wood extract

	Control	40% glycerine	Sappan wood extract		
			250 mg/kg	500 mg/kg	1,000 mg/kg
Glucose (mg/dl)	99.30 ± 3.72	106.10 ± 3.46	99.10 ± 5.37	99.70 ± 8.22	98.57 ± 7.33
BUN (mg/dl)	25.60 ± 0.96	23.50 ± 1.00	24.00 ± 1.12	27.60 ± 1.42	25.14 ± 2.32
Creatinine (mg/dl)	0.44 ± 0.03	0.44 ± 0.03	0.44 ± 0.03	0.50 ± 0.06	0.43 ± 0.02
Total protein (g/dl)	5.53 ± 0.06	5.54 ± 0.08	5.65 ± 0.14	6.12 ± 0.32*	5.79 ± 0.11
Albumin (g/dl)	3.92 ± 0.06	3.97 ± 0.05	3.92 ± 0.09	3.91 ± 0.09	3.79 ± 0.11
Total bilirubin (mg/dl)	0.23 ± 0.01	0.24 ± 0.03	0.25 ± 0.03	1.41 ± 1.07	0.43 ± 0.17
Direct bilirubin (mg/dl)	0.00 ± 0.00	0.02 ± 0.01	0.00 ± 0.00	0.13 ± 0.13	0.00 ± 0.00
SGOT (U/l)	125.80 ± 6.72	130.90 ± 8.29	137.90 ± 7.60	275.10 ± 68.93*	185.00 ± 25.88
SGPT (U/l)	24.50 ± 1.40	25.30 ± 2.12	27.00 ± 1.83	47.20 ± 13.58*	30.10 ± 1.40
ALP (U/l)	51.20 ± 4.25	38.80 ± 2.80	53.60 ± 3.28	50.60 ± 6.29	70.57 ± 10.09*

Values are expressed as mean ± SEM, n = 10, * Significantly different from control, $p < 0.05$

Table 6. Clinical blood chemistry examinations of male rats under subacute doses of Sappan wood extract

	Control	40% glycerine	Sappan wood extract		
			250 mg/kg	500 mg/kg	1,000 mg/kg
Glucose (mg/dl)	133.60 ± 5.61	123.70 ± 3.49	158.90 ± 16.62	147.70 ± 12.00	127.60 ± 12.58
BUN (mg/dl)	21.90 ± 1.11	21.80 ± 0.80	26.30 ± 1.60*	23.30 ± 1.21	20.90 ± 0.59
Creatinine (mg/dl)	0.36 ± 0.02	0.38 ± 0.02	0.40 ± 0.02	0.39 ± 0.02	0.39 ± 0.03
Total protein (g/dl)	5.47 ± 0.07	5.72 ± 0.06	5.74 ± 0.11*	5.58 ± 0.09	5.60 ± 0.11
Albumin (g/dl)	3.85 ± 0.04	3.90 ± 0.04	3.93 ± 0.08	3.70 ± 0.09	3.82 ± 0.06
Total bilirubin (mg/dl)	0.17 ± 0.01	0.14 ± 0.02	0.16 ± 0.02	0.15 ± 0.02	0.23 ± 0.05
Direct bilirubin (mg/dl)	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.10 ± 0.10
SGOT (U/l)	123.30 ± 5.95	125.30 ± 13.37	116.20 ± 6.66	118.70 ± 7.69	144.90 ± 21.02
SGPT (U/l)	30.00 ± 1.64	29.00 ± 2.83	28.30 ± 1.46	32.40 ± 3.25	41.30 ± 9.38
ALP (U/l)	97.40 ± 8.82	93.10 ± 5.29	105.40 ± 4.71	115.60 ± 8.29	107.50 ± 6.69

Values are expressed as mean ± SEM, n = 10, * Significantly different from control, $p < 0.05$

clinical blood chemical values were observed in both female and male rats as compared to the control groups. These parameters are the index of pancreas, kidney and liver function. However, the alteration of these values were minor changes and remained within the normal range[15,16,18,20].

Necropsy and histopathological examinations were performed to further confirm whether or not the internal organs or tissues had been damaged. But no macroscopic or microscopic changes were detected in the internal organs or tissues in any of the treatment rats. The results indicate the healthy status of liver and kidney in the treatment rats.

In conclusion, Sappan wood extract did not cause either acute or subacute toxicity in both female and male rats.

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References

1. Oh SR, Kim DS, Lee IS, Jung KY, Lee JJ, Lee HK. Anticomplementary activity of constituents from the heartwood of Caesalpinia sappan. Planta Med

1998; 64: 456-8.
2. Johnson T. CRC ethnobotany desk reference. Boca Raton: CRC Press; 1999: 135-6.
3. Warrier PK, Nambiar VPK, Ramankutty C. Bombax Ceiba. In: Warrier PK, Nambiar VPK, Ramankutty C, editors. Indian medicinal plants: a compendium of 500 species. Vol. I. Chennai, India: Orient Longman; 1993: 291-3.
4. Caesalpinia sappan Linn. [database on the Internet]. 2010 [cited 2010 Mar 26]. Available from: http://www.bpi.da.gov.ph/Publications/mp/pdf/s/sapang.pdf
5. Moon CK, Park KS, Kim SG, Won HS, Chung JH. Brazilin protects cultured rat hepatocytes from BrCCl3-induced toxicity. Drug Chem Toxicol 1992; 15: 81-91.
6. Baek NI, Jeon SG, Ahn EM, Hahn JT, Bahn JH, Jang JS, et al. Anticonvulsant compounds from the wood of Caesalpinia sappan L. Arch Pharm Res 2000; 23: 344-8.
7. Niranjan R, V, Ravikanth V, Jansi L, V, Suryanarayan MU, Venkateswarlu Y. Inhibitory activity of homoisoflavonoids from Caesalpinia sappan against Beauveria bassiana. Fitoterapia 2003; 74: 600-2.
8. Badami S, Moorkoth S, Rai SR, Kannan E, Bhojraj S. Antioxidant activity of Caesalpinia sappan heartwood. Biol Pharm Bull 2003; 26: 1534-7.
9. Yingming P, Ying L, Hengshan W, Min L. Antioxidant activities of several Chinese medicine herbs. Food Chem 2004; 88: 347-50.
10. World Health Organization. General guidelines for methodologies on research and evaluation of traditional medicine. Geneva: WHO; 2000.
11. Organization of Economic Co-operation and Development. OECD Guideline for testing of chemicals: Test guideline 420. Acute oral toxicity-fixed dose method. Paris: OECD; 2001.
12. Organization of Economic Co-operation and Development. OECD Guidelines for the testing of chemicals: Test guideline 407. Repeated Dose 28-day oral toxicity study in rodents. Paris: OECD; 2001.
13. Feldman BF, Zinkl JG, Jain NC, Moor DM. Schalm's veterinary hematology. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2000.
14. Inala P, Sirimontaporn A, Inpunkaew R, Rungrojejinda K, Kengkoom K, Ratanasak W, et al. Hematological analysis of outbred Sprague-Dawley rat in the Facility of National Laboratory Animal Centre. 28th Congress on Science and Technology of Thailand; 2002.
15. Caisey JD, King DJ. Clinical chemical values for some common laboratory animals. Clin Chem 1980; 26: 1877-9.
16. Sacher RA, McPherson RA. Test of liver function. In: Sacher RA, McPherson RA, Campos JM, Widmann FK, editors. Widmann's clinical interpretation of laboratory test. 11th ed. Philadelphia: F.A. Davis; 2000: 562-99.
17. Young LY, Holland EG. The clinical use of drugs: Interpretation of clinical laboratory tests. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 1995: 4-20.
18. Levine BS. Animal clinical pathology. In: Derelanko MJ, Hollinger MA, editors. Handbook of toxicology. 2nd ed. Boca Raton: CRC Press; 2002: 742-68.
19. Koller A, Kaplan LA. Total serum protein. In: Pesce AJ, Kaplan LA, editors. Methods in clinical chemistry. St. Louis, MO: Mosby; 1987: 1134-44.
20. Angkhasirisap W, Inala P, Sirimontaporn A, Inpunkaew R, Rungrojejinda K, Kengkoom K, et al. Blood chemistry profiles of outbred Sprague-Dawley rat in The Facility of National Laboratory Animal Centre. 28th Congress on Science and Technology of Thailand; 2002.

การประเมินความเป็นพิษของสารสกัดแก่นฝางในหนูขาว

สีวบูรณ์ สิรีรัฐวงศ์, ปริศนา ปิยะพันธุ์, ทิพยา สิงหลักษณ์, ยุวดี วงษ์กระจ่าง, รุ่งระวี เต็มศิริถุกษ์กุล, จักรพันธุ์ พันธุ์ศรีรัตน์, นงลักษณ์ เรืองวิเศษ, สุมาลย์ สาระยา, นุชสิริ เลิศวุฒิโสภณ, กาญจนา ใจจ้อย

ภูมิหลัง: *แก่นฝางมีการใช้ในยาพื้นบ้านมาเป็นระยะเวลานานเพื่อใช้รักษาวัณโรค ท้องเสีย การติดเชื้อที่ผิวหนัง และโลหิตจาง*

วัตถุประสงค์: *เพื่อประเมินความเป็นพิษเฉียบพลันและกึ่งเฉียบพลันของสารสกัดแก่นฝางในหนูขาว*

วัสดุและวิธีการ: *การศึกษาความเป็นพิษเฉียบพลันจะป้อนสารทางปากครั้งเดียวในขนาด 5,000 มก./กก. ให้แก่หนูขาว ความเป็นพิษกึ่งเฉียบพลันจะศึกษาโดยป้อนสารในขนาด 250, 500 และ 1,000 มก./กก. ทางปากทุกวันเป็นเวลา 30 วัน*

ผลการศึกษา: *แก่นฝางในขนาด 5,000 มก./กก. ไม่ก่อให้เกิดความเป็นพิษโดยไม่ทำให้มีการเปลี่ยนแปลงของพฤติกรรรมการตาย หรือการเปลี่ยนแปลงของอวัยวะภายใน การศึกษาความเป็นพิษกึ่งเฉียบพลัน ไม่พบความผิดปกติต่างๆ ในกลุ่มที่ได้รับสารทดสอบเมื่อเทียบกับกลุ่มควบคุมทั้งน้ำหนักตัว น้ำหนักอวัยวะภายใน ค่าทางโลหิตวิทยา ค่าเคมีคลินิกในเลือด การผ่าพิสูจน์ซาก และลักษณะทางมหภาคและจุลภาคของอวัยวะภายใน*

สรุป: *สารสกัดแก่นฝางไม่ก่อให้เกิดทั้งความเป็นพิษเฉียบพลันและกึ่งเฉียบพลันในหนูขาวเพศเมียและเพศผู้*