

\*\*\* A PRELIMINARY STUDY ON THE TOXICITY TO  
CATTLE OF CROTALARIA JUNCEA

(การศึกษาเบื้องต้นถึงการเป็นพิษของปอเทืองที่มีต่อวัว)

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**Abstract**

The *Crotalaria juncea* was planted on the upland, sandy soil of Khon Kaen. The flowered plant was cut and dried under direct sunlight for two days. The resulting hay was kept indoors throughout the experiment. The hay samples were ground and shipped to the U.K. for determination of pyrrolizidine alkaloid. The proximate analysis for nutritional values was carried out by the nutrition laboratory of the Faculty of Agriculture, Khon Kaen University (K.K.U.). The hay was fed ad libitum to twelve native cattle freed from diseases for 4 months. The animal's growth rate was recorded and the general condition examined consistently. The blood samples were drawn at two-week intervals for analysis. Immediately after slaughtering, we performed a systematic post-mortem examination. The representative pieces of vital organs were promptly fixed in

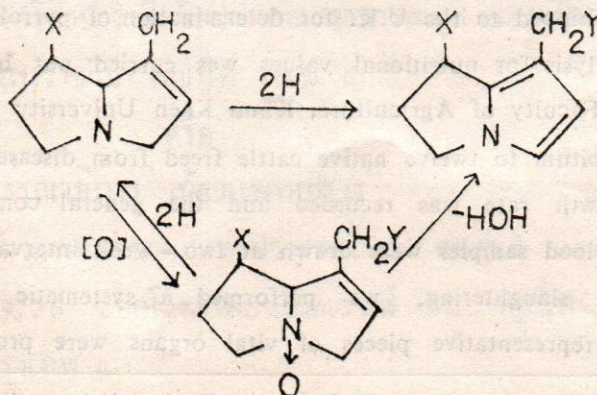
\*\*\* Supported by Pasture Improvement Project of Thai and Australian Government.



Carnoy's fixative and processed through the histopathological technique. The glass slides prepared from the organs amounted to 840, these were done in the micro-anatomy section of Anatomy Department, Faculty of Medicine, K.K.U. We found that the plant is rich in protein. It promotes growth better than the rice straw considerably. The pyrrolizidine alkaloid content is about 0.001-0.01%. The average alkaloid consumed in 4 months was 20.02 gm. per 100 kg. body weight. The organs did not show pathological changes as judged by the microphotograph under the light microscope. The blood picture is discussed.

### Introduction.

*Crotalaria juncea* (Sunnhemp) has been grown extensively in India to make a high quality paper. It is usually planted in the paddy field after rice harvesting. The plant is rich in cellulose but contains only a small amount of lignin and a negligible quantity of ash. Indian farmers in the Krishna Delta have also used it to mix with rice straw as a feed for cattle (Shelton, 1979). The flowering plants are cut 50-60 days after sowing and dried in the sun before feeding. The Indian sunnhemp contains 14.82% protein, 1.22% calcium, and 0.28% phosphorus (Jayal & Johri, 1977). Adams and Gianturco (1956) reported that sunnhemp was toxic to liver cells in some animals. The pyrrolizidine alkaloids which are found in *Crotalaria* species, *Senecio* spp., *Heliotropium* spp., *Trichodesma* spp., and *Echium* spp. are reportedly hepatotoxic (Hooper, 1968). Pyrrolizidine alkaloids are in the form of N-oxide and its tertiary base and the amounts vary with the age of the plant, e. g., prior to flowering, some of the alkaloid, about 5% of dry weight, is in the form of N-oxide but this form disappears completely after flowering (Mattocks 1971). The various forms are illustrated as follows:





Sunnhemp is used in Northeast Thailand predominantly as a green manure. However the plant has a high protein content and it grows readily in the dry season after rice. Thus it could be of value as a high quality dry season fodder, but because of its potential toxic effect it was of interest to find out 1) its toxicity to cattle, 2) the pyrrolizidine content and nutritional value of sunnhemp grown in Khon Kaen, and 3) its effect on general health as judged by growth rate and blood picture. This is aimed at obtaining scientific data to justify the extension of sunnhemp to the farmers. If this study proves that sunnhemp is harmless to the cattle, it would be an excellent forage crop for the farmers to produce good hay to promote the cattle's health in the dry season. This is a conceivable way of increasing the farmers' income eventually.

### Material and Method.

#### A. Preparation of the Sunnhemp Hay.

The sunnhemp was planted on the sandy, upland soils of K.K.U., Ta-pra Agricultural Research Center, and Khon Kaen Lane Development Center. When the sunnhemp flowered it was cut and dried in the sun for 2 days. The hay was kept indoors throughout the experiment.

#### B. Sunnhemp Analysis for Alkaloid Content.

The alkaloid content in samples of sunnhemp was determined at the MRC Toxicology Unit, Medical Research Council Laboratory, Surrey, United Kingdom.

Dry samples including stem, flower, and leaves were collected at random, ground and packed in plastic boxes. They were sent by air mail to the above laboratory in the U.K. for analysis.

#### C. Analysis for Nutritive Value.

Dry samples were collected as above but were packed in plastic bags and analysed in the Animal Nutrition Laboratory, Khon Kaen University, Thailand.

#### D. Animal Experiment

Twelve native cattle, 1½ years of age, were quarantined for a period of 2 weeks. External parasites were treated by spraying chlorinated hydrocarbons twice. Internal parasites were controlled by drenching with rafoxanide for fluke and thiabendazole for round worm. A period of two weeks was judged as adequate for conditioning the animals to the experimental conditions. During



the two-week period, the animals were kept under close observation and found to be in good health as no clinical signs of any disease were observed.

The animals were divided into 4 groups:

Group I. Numbers 2489, 2490 and 2498 were fed with rice straw as a realistic control group.

Group II. Numbers 2491, 2492 and 2496 were fed with sunnhemp hay alone.

Group III. Numbers 2493, 2497 and 2500 were fed with 75% rice straw + 25% sunnhemp.

Group IV. Numbers 2494, 2495 and 2499 were fed with 75% rice straw + 25% *Stylosanthes hamata* cv. Verano (Verano stylo). Verano stylo is widely grown in the Northeast as a cattle fodder and has proved harmless to cattle. It was included here as another control.

The animals were fed ad libitum for 4 months. At the conclusion of the feeding period they were slaughtered and examined grossly. Representative pieces of liver, heart, kidney, lung, jejunum, abomasum and lymph node were collected for histopathological studies. This was done in the micro-anatomy section of the Department of Anatomy, Faculty of Medicine, Khon Kaen University.

#### E. Blood Examinations.

Blood samples were drawn from each animal every two weeks for laboratory analysis. The following analyses were carried out: total erythrocyte count, total leucocyte count, differential white count, hemoglobin measurement and hematocrit analysis. Since the normal values for native cattle were not available, it was decided to record the values prior to the experiment as a base line. This was achieved by averaging three blood-samples drawn at a week intervals.

### Results.

The pyrrolizidine alkaloid content is presented below.

Table 1. Pyrrolizidine Alkaloid Content of Sunnhemp.

Sample	% Of Alkaloid (N-oxides & base)
I	0.006
II	0.002
III	0.001
IV	0.001
V	0.007
VI	0.01



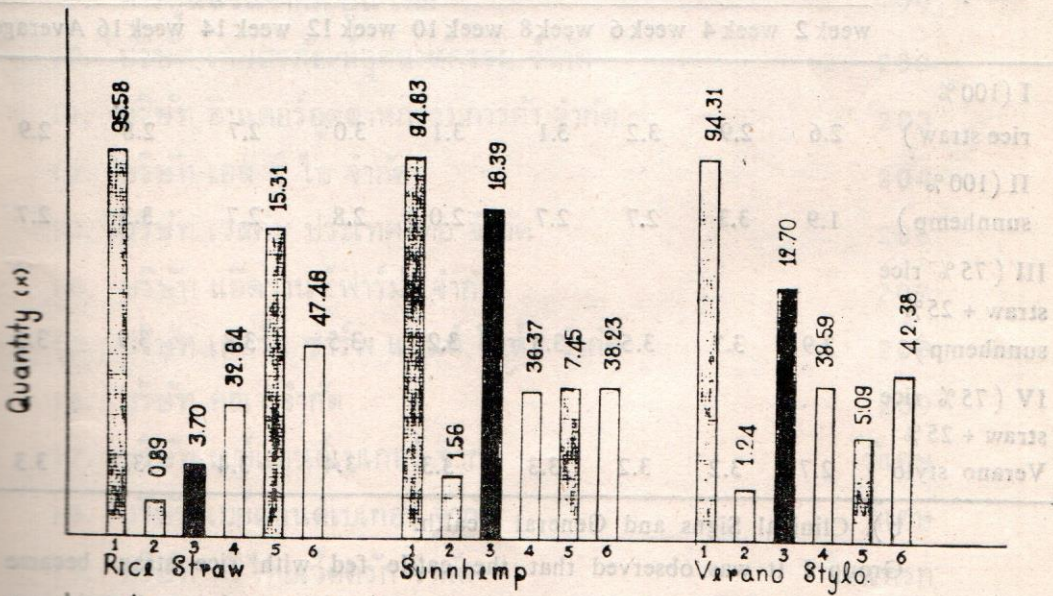
Table 2. Estimated Consumption of Alkaloids (calculated every two weeks and based on table 1.)

Group No.	Consumption of Alkaloid (gm. per 100 kg. body weight)								
	week 2	week 4	week 6	week 8	week 10	week 12	week 14	week 16	Total
II 100 % Sunnhemp	2.55	2.34	1.48	0.78	0.77	0.80	3.90	7.40	20.02
III 75% Rice straw + 25% Sunnhemp	0.81	1.56	1.56	0.38	0.31	0.32	0.78	2.34	8.46

Nutritional Values of Sunnhemp

This is presented in a graphic form below.

Histogram Representing the Nutritional Values.



Legends

- 1 [Solid Black] = Dry Matter
- 2 [White] = Ether Extract
- 3 [Solid Black] = Crude Protein
- 4 [White] = Crude Fiber
- 5 [White with Dots] = Ash
- 6 [White with Dots] = Nitrogen-Free Extract

SS/CM



### General Observations.

#### a). Voluntary Feed Consumption.

The animals in group I consumed rice straw readily as expected for native cattle of Thailand.

Group II Animals required approximately one week to adapt to the feed. As the trial progressed they appeared to relish eating the sunnhemp hay (Table 3).

Group III Animals preferred rice straw in the first 3 days. After about a week they began to select sunnhemp in preference to rice straw. Left-over material was found to be only the stems of sunnhemp and rice straw.

Group IV Animals readily accepted the combination of rice straw and Verano stylo.

The feed consumption of each animal is presented below.

Table 3. Feed Consumption.

Group No.	Average Feed Consumption Determined Every Two Weeks (kg./head/day)								Average
	week 2	week 4	week 6	week 8	week 10	week 12	week 14	week 16	
I (100% rice straw)	2.6	2.9	3.2	3.1	3.1	3.0	2.7	2.8	2.9
II (100% sunnhemp)	1.9	3.3	2.7	2.7	2.0	2.8	2.7	3.3	2.7
III (75% rice straw + 25% sunnhemp)	2.9	3.7	3.5	3.3	3.2	3.5	3.8	3.9	3.5
IV (75% rice straw + 25% Verano stylo)	2.7	3.2	3.2	3.3	3.3	3.4	3.4	3.7	3.3

#### b). Clinical Signs and General Health.

Group I It was observed that the cattle fed with rice straw became progressively emaciated. They were less active; their skin was dry and their coat looked "rough" However, they showed no signs of nervous system disorder. Their eyes were normally bright with no excretion and their urine and feces were normal. No photosensitization was observed but at the end of the experiment they were physically weak.