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"LEUCAENA LEUCOCEPHALA": A NEW FORAGE FOR FARM ANIMALS IN EGYPT. 2- THE CHEMICAL COMPOSITION OF LEUCAENA LEAVES AND MIMOSINE DETOXIFICATION AT DIFFERENT STAGES OF MATURITY

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SUMMARY

The chemical composition,minerals and mimosine contents of leucaena leaves were determined at 4,5,6,7,9 and 12 months from planting. The results showed that CF, ash and NFE % seemed to increase gradually by age, while CP and EE content were shown to be more higher at the early stages of growth and then decreased gradually from stage to another. Phosphorus, Fe, Zn, Cu and Mn decreased gradually while Ca, K, Mg and Na increased by advancement of maturity.

The effect of age and method of drying on mimosine content of leucaena leaves showed that mimosine content declined by advance in age of plant and also decreased by increasing the temperature of drying. Mean values of mimosine content were 1.92, 1.61, 1.35, 1.00 and 0.64% for fresh, sun dried, dried under vacuum at 50°C and 80°C and oven dried at 80°C 3hr, respectively.

INTRODUCTION

Leucaena leucocephala is a multipurpose leguminous plant, which is considered as a green legume used for animal feeding in tropical and subtropical areas. It has a high content of protein, carotene and energy (Devendra, 1987). It gives also a high yield of green feed. There are controversial reports in the literature regarding the

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suitability of feeding leucaena to ruminants because it contains substances like mimosine (Singh and Mudgal, 1967; Upadhyay et al., 1974 and Jones et al., 1976). Certain reports indicated that it can be fed safely to cattle and buffaloes to the extent of 30-40% of the green forage (Jones et al., 1978 and Hiremath, 1981). The present study was carried out to determine the chemical composition, minerals and mimosine contents of leucaena leaves at different stages of maturity. The effect of different methods of drying on detoxification of mimosine was also studied.

MATERIALS AND METHODS

Leucaena plants were cultivated at the Experimental Station of the National Research Center, Shalakan, Kalubia Governorate during July 1987. Representative samples were taken from plant leaves at 4,5,6,7,9 and 12 months from planting, then sun dried to about 90% DM, finely ground and kept for chemical analysis and minerals assay.

To remove the toxicity of mimosine content of leucaena, four methods of drying were applied. Further samples from the plant leaves were taken at 5,6,7,9 and 12 months from planting. The drying methods were follows:

1- Sun drying to about 90% DM.
2- Oven drying at 80°C for 3 hr.
3- Oven drying under vacuum at 50°C for 3 hr.
4- Oven drying under vacuum at 80°C for 3 hr.

The dried samples were finely ground and kept in plastic containers for mimosine determination as described by Tangendjaja and Wills (1980). Mimosine was also determined for fresh plant samples as a control.

Leucaena leaves were analysed for CP, EE, CF, ash and NFE according to A.O.A.C. (1980) and for minerals as mentioned by Jackson (1958) using atomic absorption spectrophotometer (IL-S-12), while total phosphorus was determined in the ash, according to Troug and Meyer (1939).

Mimosine was determined in Mycotoxins Central Laboratory by using liquid chromatography model 6000 A solvent delivery system, model 720 system controller, model 730 data module, UGK injector and differential UV detector (280 mm). Rapid elusion and good separation of mimosine in standard solution was obtained using a solvent system of 0.2% (w/v) orthophosphoric acid in double distilled water at a flow rate of 1 m/min. Fresh leaf samples of leucaena were prepared for analysis by freeze drying. Dried leaf (25 mg) was ground manually in a mortar with 0.1N HCL (10 ml) to extract mimosine (Hegarty et al., 1964), the mixture was centrifuged for 10 min. at 7500 g and the supernatant was filtered under nitrogen (60 P.S.I.) through an

ultrafilter membrane. The method was based on the principles reported by Tangendjaja and Wills, (1980).

RESULTS AND DISCUSSION

Chemical composition of leucaena leaves:

The chemical composition of leucaena leaves (on DM basis) at different stages of maturity are shown in Table (1).

Table (1): Effect of advance in maturity on chemical composition of sun dried leucaena leaves (on DM basis).

Items		Months from planting					
		4	5	6	7	9	12
Dry matter	(%)	88.5	90.2	92.6	93.9	95.0	95.8
Composition of DM:							
Ash	(%)	6.9	6.4	8.5	9.1	9.9	10.1
Organic matter	(%)	93.1	93.6	91.5	90.9	90.1	89.9
Crude protein	(%)	39.0	37.6	33.0	31.0	29.6	27.0
Ether extract	(%)	7.2	4.5	5.6	5.2	5.0	5.8
Crude fibre	(%)	13.0	14.5	15.7	16.2	17.0	17.8
Nitrogen free extract	(%)	33.9	37.0	37.2	38.5	38.5	39.3

Crude protein and ether extract contents were shown to be more higher at the early stages of maturity and then decreased gradually from stage to another. On the other hand, minimum crude fibre percentage was shown at early stages of growth, and then started to increase gradually and get the maximum percentage at 12 months from planting. Similar trend was observed concerning nitrogen free extract content. It could be concluded that as leucaena plants mature, the percentages of crude protein and ether extract decrease, while crude fibre and NFE contents increase. This indicates that plants at the later stages of growth was going towards more carbohydrates than protein and fats. Similar results have been reported by Adeneye (1979) and El-Ashry et al. (1992) who found that young leaves or leaves + branches contained more CP but lower CF and NFE content than mature ones.

Ash content was shown to increase as the age of the plant increased, lowest ash content was recorded at the 5th month of age. The gradual increase in total ash content with age may be due to the increase in water minerals absorption rate from the soil by the root system which result in the increase in the dry matter formation.

The present results of the chemical composition of leucaena leaves are within the range reported by Dingayan and Fronda (1950), Upadhyay et al., (1974), Devendra (1986) and Abo El-Nor (1987). They found that on DM basis the percent of CP of leucaena leaves ranged from 21.0 to 36.0, CF from 19.6 to 25.3, EE from 3.9 to 9.4, ash from 4.4 to 7.5 and NFE from 36.5 to 47.9%.

Minerals content of leucaena leaves:

Minerals content of leucaena leaves at different stages of maturity (Table 2) showed that phosphorus percentage was higher (0.750%) at the earliest stage of growth than the other stages and then decreased gradually from stage to another and reached the lowest value (0.421%) at 12 months of age. Sodium, calcium, potassium and magnesium contents (Table 2) were shown to be lowest at the 4th month of maturity, being 0.202, 1.264, 2.190 and 0.186%, respectively and then increased gradually from stage to another. The corresponding percentages at 12 months from planting were 0.663, 3.064, 3.121 and 0.353. The present results indicate that leucaena leaves content from phosphorus, calcium, sodium and potassium were higher than that of magnesium.

Table (2): Effect of advance in maturity on minerals content of sun dried leucaena leaves (on DM basis).

Items		Months from planting					
		4	5	6	7	9	12
Phosphorus	(%)	0.750	0.578	0.541	0.511	0.444	0.421
Sodium	(%)	0.202	0.232	0.270	0.307	0.423	0.663
Calcium	(%)	1.264	1.442	1.766	2.676	2.693	3.064
Potassium	(%)	2.190	2.460	2.543	2.530	2.917	3.121
Magnesium	(%)	0.186	0.217	0.239	0.292	0.321	0.353
Copper	(ppm)	68.296	52.472	45.890	39.980	27.878	24.580
Iron	(ppm)	55.710	53.149	49.750	48.99	39.560	35.648
Zinc	(ppm)	40.058	38.245	35.082	21.500	16.020	12.919
Manganese	(ppm)	55.830	52.820	51.018	43.440	40.600	28.734

The studied micro elements: copper, iron, zinc and manganese were shown to get the same trend of phosphorus content (Table 2). The concentration of these micro elements were decreased gradually with increasing age. It could be concluded that as leucaena plant matures, the concentration of micro elements were decreased, while macro elements content except phosphorus were increased.

Values obtained for calcium and magnesium contents of leucaena leaves at 12 months age were nearly similar to those obtained by Adeneye (1979) for mature leaves. However, the present values obtained for phosphorus, potassium and sodium contents were somewhat higher than those reported by Adeneye (1979).

Mimosine content of leucaena leaves and its detoxification:

The effects of different methods of drying as means of detoxification on mimosine content of leucaena leaves at different stages of maturity are shown in Table (3) and Fig. (1).

Table (3): Effect of different methods of drying (detoxification) and advance in maturity on mimosine content of leucaena leaves.

Treatments	Concentration of mimosine (% DM basis)					Overall means
	Months from Planting					
	5	6	7	9	12	
Fresh (freeze drying)	3.22	2.95	1.93	0.79	0.69	1.92
Sun dried	2.78	2.49	1.73	0.58	0.48	1.61
Dried under vacuum:						
at 50°C	2.33	2.05	1.38	0.53	0.44	1.35
at 80°C	1.91	1.31	0.99	0.48	0.31	1.00
Over dried at 80°C	1.04	0.91	0.84	0.32	0.10	0.64
Overall means	2.26	1.94	1.37	0.54	0.40	

The present data indicated that mimosine content has a similar trend as CP content in relation to the stage of maturity. The highest mimosine content was found at the earlier age and decreased gradually with advancing of age. Similar results were obtained by Wong Choi Chee and Devendra (1982) who found that mimosine levels declined with maturity and the change was particularly marked among the cutting frequencies from 2 to 8 weeks. On the other hand, Guevarra et al., (1978) reported that cutting regimens from 10 to 16 weeks did not produce differences in averages mimosine content.

Data of Table (3) indicated that mimosine content of leucaena leaf within each maturity stage were reduced with increasing temperature of drying. The overall means were 1.92, 1.61, 1.35, 1.00 and 0.64% for fresh, sun dried, dried under vacuum at 50°C and 80°C and oven

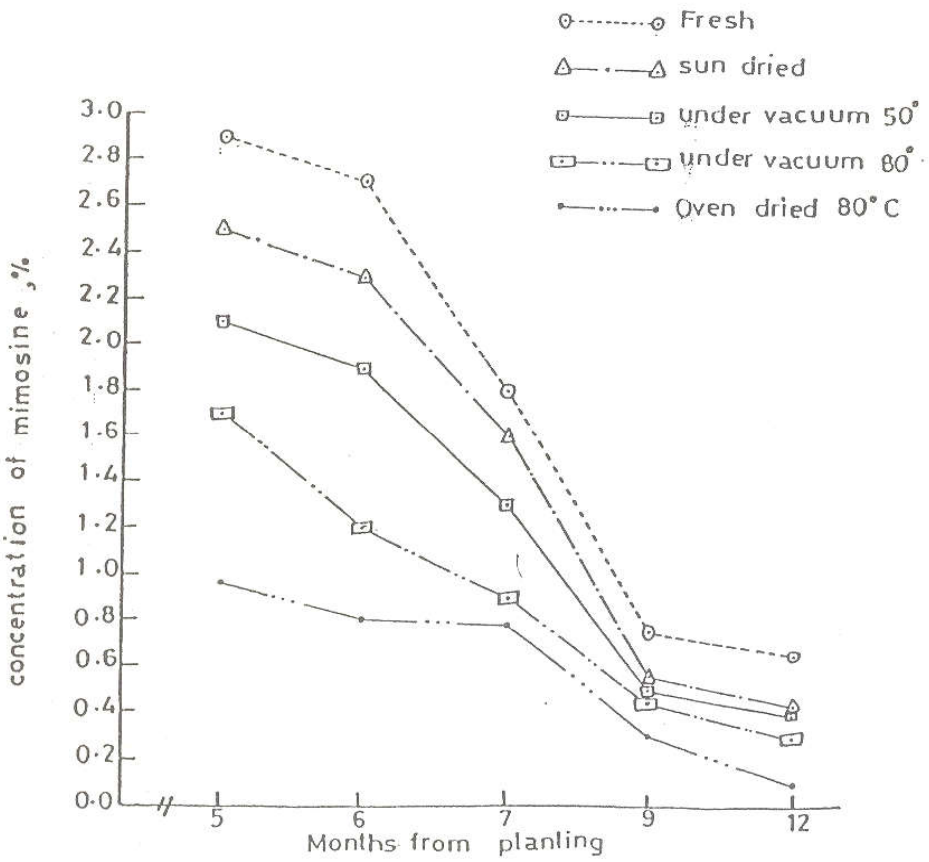

Fig.(1):Effect of method of detoxification and advance in maturity on mimosine content of leucaena.

dried at 80°C, respectively. These results were in agreement with those of Wong Choi Chee and Devendra (1982), who indicated that mimosine content of leucaena leaves was lowest with sudden heating on temperatures higher than 70°C and contact with acid. They assumed on the basis of their results that drying leucaena under vacuum or by rapid heating cause decreasing of mimosine in leucaena leaves which becomes of almost no activity on rehydration. Moreover, Lowry (1983) found that treating leucaena at 45°C had very little effect on mimosine, while at temperature higher than 70°C the enzyme is denatured (leucaena contain an enzyme that catalyzes the hydrolysis of mimosine to DHP pyruvic acid and ammonia, Smith and Fowden, 1966).

The present study tend to suggest that leucaena leaves is a promising green forage of high CP content that can successfully be used in rations for ruminants. The toxicity of mimosine could be reduced using different methods of drying and by advancing maturity of the plant. Future work is needed to study the effect of using leucaena hay in rations for ruminants on feed intake nutrients digestibility and animals performance.

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"نبات الليوكينا كعلف جديد للحيوانات المزرعية فى مصر "

٢- التركيب الكيماوى لاوراق نبات الليوكينا وازالة سمية مادة الميموزين على مراحل مختلفة من نضج النبات

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خلال هذه الدراسة تم تقدير التركيب الكيماوى ومحتوى اوراق نبات الليوكينا من العناصر المعدنية ومادة الميموزين ، وذلك بعد مرور ٤ ، ٥ ، ٦ ، ٧، ٩ ،١٢ شهر من الزراعة. وقد اوضحت النتائج ارتفاع محتوى النبات تدريجيا من الالياف الخام والرماد ومستخلص خال الازوت بتقدمه فى العمر (مرحلة النضج) ، بينما لوحظ ارتفاع محتوى النبات من البروتين الخام ومستخلص الاثير فى المراحل المبكرة للنمو وانخفاضه تدريجيا بتقدم النبات فى العمر . كذلك لوحظ انخفاض محتوى النبات من العناصر المعدنية مثل الفسفور ، الحديد ، الزنك ، النحاس والمنجنيز بينما يرتفع محتواه من عناصر الكالسيوم والبوتاسيوم والماغنسيوم والصوديوم بتقدم النبات فى العمر (او النضج).

كذلك اوضحت الدراسة انخفاض محتوى اوراق النبات من مادة الميموزين تدريجيا بتقدم النبات فى العمر. وقد اوضحت الدراسة انه بزيادة درجة الحرارة المستخدمة فى تجفيف النبات انخفض محتوى اوراق النبات من مادة الميموزين ذات التاثير السام ، وكان تركيز مادة الميموزين ١,٩٢ ،١,٦١، ١,٣٥ ، ١,٠ ، ٠,٦٤٪ من المادة الجافة للاوراق الطازجة ، المجففة شمسيا أو المجففة لمدة ٣ ساعات تحت تفريغ اما عند درجة ٥٥٠م أو ٨٠٠م أو المجففة بالفرن العادى على درجة ٨٠٠م على الترتيب.