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A STUDY OF HCN CONTENT IN SOME FODDER CROPS USED IN FEEDING ANIMAL

By

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It was intended to study the HCN content in some of the summer and winter fodder crops used in feeding animals. The summer fodder crops studied were : sweet sorghum, sudan grass, grain sorghum, millet and green corn (darawa). The winter crops studied were : barley, miskawi and Fahl clover

It was found that the amount of HCN present in any stage of growth differs from one crop to another, although the crops were grown under the same conditions and got the same treatment. The sudan grass tended to contain the highest level of HCN followed by sweet sorghum, grain sorghum and millet, while green corn (darawa) was the lowest.

The amount of HCN in any plant was the highest at the seedling stage and decreased as the plant advanced in age.

It was found that the amount of HCN decreased by exposing the plants to sunshine for one hour. Significant differences exist between the fresh samples and those exposed to sunshine.

The cyanogenetic glucosides have been responsible for large losses of livestock all over the world. Treatment of animals poisoned by cyanogenetic plants is usually not practical, because most of the losses may have been occured at the time the poisoning is discovered. The prompt control of such poisoning in animals is firct and foremost a mater of prevention.

In Egypt, Sorghun vulgare and green corn (darawa) are grown mainly in summer as grain crops. It is a usual practice to grow the plants very close at the beginning, then after about three weeks from seeding, and before adding the fertilizers the plants are thinned out. The Egyptian farmers from their experience, never give such thinnings as a fodder to their animals, before wilting. In this study an attempt was made to determine the level of HCN present in some summer fodder crops and to study the effect of wilting on its content in these plants.

Moreover the amount of HCN was determined in two strains of Egyptian clover and in barley to throw a light on their HCN content and their ability to cause poisoning.

Review of Literature

Some experimental trials were carried out at the beginning of this century by many investigators all-over the world. Dunstan and Henry (1902), perhaps were the pioneers in determining HCN in sorghum.

The glucoside (dhurrin) was isolated by the authors from samples of Andropogon sorghum called (Dhurra) grown in Egypt, which on hydrolysis yield giucose ; parahydroxybenzaldehyde and HCN.

Coleman (1934), Tarantino (1935), Martin *et al.* (1938), Franzke and Hume (1945), Klosterman *et al.* (1951), Fevero (1953) and Taranenko (1958), reported that for the normal plant as a whole, the HCN content was the highest in the earlier stages of growth and decreased as the season advanced. the maximum amount of HCN was found by Bagchi and Ganguly (1941), in the sprouts 72 hours after germination, when the plant was one inch in length.

Swanson (1921), thought that the difference is perhaps due to the large proportion of stems in the latter part of the season, since if leaves only are compared there is very little difference. Martin *et al.* (1938), and Franzke *et al.* (1939), made separte analysis for HCN from leaves and branches. They found that HCN content of leaves was higher than that of the corresponding stalks of sorghum plants.

In determining the effect of the rate of drying on HCN content, Dowell (1919)) and Swanson. (1921), found that the fresh samples gave large amounts of HCN, that dried in the oven somewhat less, that dried in the sun still less and that dried slowly in the shade none or only a trace. On the other hand, Boyed *et al.* (1938), noticed that air drying or sun curing did not lower the HCN content and plants which were high in poison at the time of cutting did not lose appreciable quantities of cyanide.

Lall (1946) and Massey (1959), mentioned that so long as the leaves of sorghums are green and fresh with no wilting, the glucoside remains as such. The authors concluded that only wild plants are poisonous. While. Swanson (1921), made immediate tests on frosted sudan grass and noticed that very large amount of HCN was given but disappeared rapidly as soon as the plant began to wilt.

Doak (1935) and Corkill (1942), reported that white clover plants contain cyanogenetic glucosides, which, when hydrolyzed liberate HCN. The former added that there is no evidence to show that the quantity of plant eaten by stock is sufficient to cause poisoning.

Experimental and Methods

It was intended to obtain some information about the HCN content of some of the most important green fodder crops in Egypt. The summer fodder crops studied were :— sweet sorghum, sudan grass, grain sorghum, millet and green corn darawa). The winter crops studied were : barley and two strains of Egyptian clover (*Trifolium alxandrinum*) miskawi and fahl clover. The experiment was carried out at the experimental farm of the Faculty of Agriculture, Giza.

Samples from summer crops were taken every two days seven days after germination. Somples of grain sorghum, millet and green corn darawa) were taken till the 11th day after germination. Samples of both sudan grass and sweet sorghum were continued to be taken till the 13th day.

Samples for analysis from winter crops were taken daily three days after germination in case of barley and eight days after gennination in case of clover. The samples were continued to be taken until the HCN was nil in the plants.

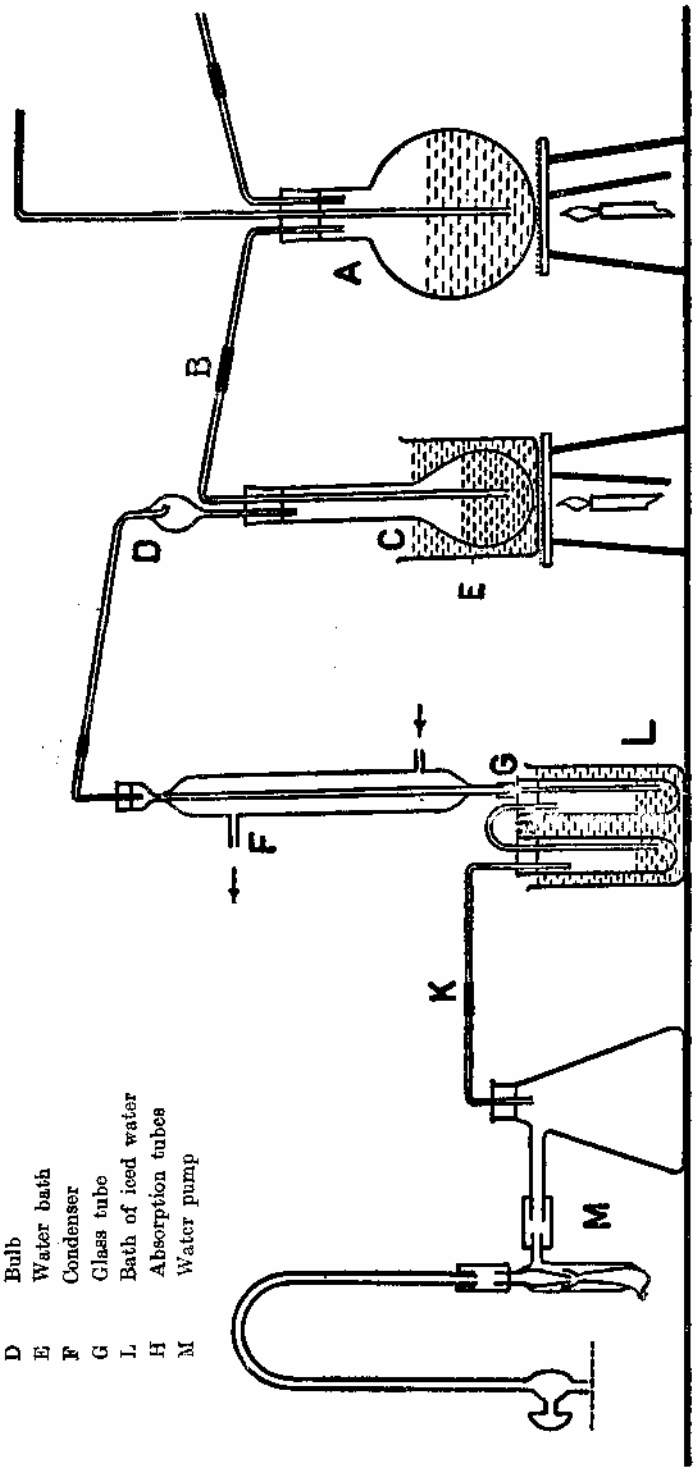
Sampling : Samples for analysis were taken in the early morning by cutting the plants just above the ground level. They were brought directly from the field to the laboratory and weighed. The material was chopped for analysis into small pieces one cm. length and thoroughly mixed by hand. Samples were immediately weighed for HCN and moisture detemination in case of the fresh plants to avoid losses of moisture and HCN. Other portions were left one hour in the sun and analyzed.

HCN determination : The chemical procedure employed for the determination of cyanide was essentially as that described by Van Der Walt (1944) and the A.O.A.C. (1955). The aeration apparatus is shown in Fig (1).

Results and Discussion

The results of HCN content of the seedling stage for the different summer fodder crops are shown in Table (1). At the 7th day after germination the highest amount of HCN was found in sudan grass being 11.039 mg The lowest was found in green corn darawa) being 2.315 mg The values for sweet sorghum, grain sorghum and millet were 10.160, 8.452 and 4.086 mg respectively. At the 11th day after germination, the sudan grass, still, was the highest being 8.897 mg and darawa was the lowest being 0.504 mg The figures were 7.309, 7.162 and 2.017 mg. for sweet sorghum, grain sorghum and millet respectively. At this stage, it can be noticed that the HCN content in millet was about four times as that in darawa This means, that although the crops were grown under the same conditions and got the same treatments, it was obvious that the amount of HCN present in any stage differs from one crop to another. The sudan grass tended to contain the highest level followed by sweet sorghum, grain sorghum and millet, while green corn (darawa) was the lowest.

The results obtained showed that the HCN content of the plant tissue for the different fodder crops studied were the highest during the first days after germination and decreased gradually as the plants advanced in maturity. These results are in good agreement with those obtained by Coleman (1934), Tarantion (1935), Martin *et al.* (1938), Franzke and Hume (1954), klostermman *et al.* (1951). Favero (1935) and Taranenko (1953).



A Bound flask 20% NaOH
B & K Connected rubber tubes
C Kjeldakl flask
D Bulb
E Water bath
F Condenser
G Glass tube
L Bath of iced water
H Absorption tubes
M Water pump

Fig.(1) AERATION APPARATUS

TABLE 1.—COMPARISON BETWEEN HCN CONTENT OF FRESH SAMPLES AND THOSE EXPOSED TO SUNSHINE IN DIFFERENT SUMMER FODDER CROPS

Days After Germination	Sudan Grass Treatments		Sweet Sorghum Treatments		Grain Sorghum Treatments		Millet Treatments		Green Corn Treatments	
	1	2	1	2	1	2	1	2	1	2
7	11.039	3.892	10.160	3.317	8.452	1.812	4.086	0.387	2.315	0.485
9	8.230	2.248	8.555	2.135	8.355	2.179	3.498	0.077	1.139	0.308
11	8.897	2.099	7.309	1.393	7.162	1.460	2.017	0.067	0.504	0.205
13	5.921	1.476	3.869	0.763	—	—	—	—	—	—

Treatment 1.—HCN mg/100 D.M. in the fresh samples.

Treatment 2.—HCN mg/100 gm. D.M. for samples exposed to sunshine.

The amounts of HCN on the 7th and 11th day in the plants exposed to sunshine for one hour were 3.892, 2.099 ; 3.317, 1.393 ; 1.812, 1.460 ; 0.387, 0.067 ; and 0.485, 0.205 mg for sudan grass, sweet sorghum, grain sorghum, millet and green corn respectively. This means that the amount of HCN decreased by exposing the plants to sunshine. These results agreed with those obtained by Dowell (1919) and Swanson (1921). The former has reported that three fourths of the HCN is set free in the drying process.

Swanson (1921), working with sudan grass samples found that there was considerably less HCN in the dried samples than in the green ones. On the other hand, the results are in the contrary with those of Boyed *et al.* (1938), who noticed that air drying or sun curing did not lower the HCN content of sudan grass plants.

In general, results obtained in this research supported the general practice of Egyptian farmers in exposing the thinnings of darawa to sunshine before being offered to animals.

HCN content of the winter crops being studied in this work was shown in Table (2) for barley and Table (3) for miskawi and fahl clover.

TABLE 2.—HCN IN BARLEY

Days After Germination	HCN mg/100 gm D.M.	
	Fresh Samples	Samples Exposed to Sunshine
3	0.787	0.365
4	0.618	0.266
5	0.832	0.402
6	0.665	0.276
7	0.679	0.223
8	0.456	0.051
9	0.403	0.054
10	0.172	nil
11	0.049	nil
12	nil	nil
13	nil	nil

The results obtained showed that HCN content was the highest during the first days of sampling, decreased gradually till it reached 0.049 mg at the 11th day in case of barley and it was nil at the 12th day.

It is obvious, that HCN in both miskawi and fahl clover was the highest during the first days of sampling being 0.830 and 0.723 mg at the 8th day after germination. It decreased thereafter reaching nil at the 14th day as shown in Table (3).

TABLE 3.—HCN IN MISKAWI AND FAHL CLOVER

Days After Germination	Miskawi Clover mg HCN/100 gm D.M.		Fahl Clover mg HCN/100 gm D.M.	
	Fresh Samples	Samples Exposed to Sunshine	Fresh Samples	Samples Exposed to Sunshine
8	0.830	0.398	0.723	0.145
9	0.772	0.185	0.519	0.128
10	0.951	0.207	0.568	0.136
11	0.393	0.062	0.515	0.110
12	0.155	0.055	0.270	0.071
13	0.053	nil	0.055	nil
14	nil	nil	nil	nil

Samples being exposed to sunshine contained less HCN than that of the corresponding fresh ones. The amount of HCN was 0.365 mg in barley samples exposed to sunshine instead of 0.787 mg in the fresh plants at the 3rd day, 0.276 mg instead of 0.665 mg at the 6th day and 0.054 mg instead of 0.403 at the 9th day.

In case of miskawi and fahl clover, the amount of HCN decreased when the plants were exposed to sunshine being 0.398 and 1.145 mg. instead of 0.830 and 0.723 mg. at the 8th day in the fresh plants of miskawi and fahl clover respectively. The amount of HCN in the sun cured samples reached 0.055 and 0.071 mg instead of 0.155 and 0.270 mg in the fresh plants at the 12th day. This decrease may be due to HCN liberation from the green tissues as in summer fodder crops.

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دراسة كمية حامض الايدروسيانيك فى بعض محاصيل العلف الخضراء المستخدمة فى تغذية الماشية

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الملخص

قدرت كمية حامض الايدروسيانيك فى خمسة من نباتات العلف الأخضر الصيفى (الذرة السكرية ـ الذرة الرفيعة ـ حشيشة السودان ـ الدخن والدراوة) وفى ثلاثة من النباتات الشتوية (البرسيم المسقاوى والفحل والشعير) وعرفت كمية الحامض الموجودة فى كل من النباتات الطازجة وبعد تعرضها لأشعة الشمس مدة ساعة .

ولقد اتضح من النتائج أنه بالرغم من نمو جميع المحاصيل تحت نفس الظروف وذات المعاملات الزراعية فان كمية حامض الايدروسيانيك تتغير من محصول لآخر فى اى فترة من فترات النمو وكانت كمية الحامض مرتفعة فى حشيشة السودان وتقل فى كل من الذرة السكرية ثم الذرة الرفيعة والدخن أما الدراوة فكانت أقلها جميعا . وجد كذلك أن كمية الحامض تكون عالية فى دور البادرات سواء فى المحاصيل الصيفية أو الشتوية ثم تتناقص بتقدم النباتات فى العمر .

وكذلك وجد أن كمية الحامض تنخفض بتعريض النباتات لأشعة الشمس مدة ساعة بعد قطعها ولقد أوضح التحليل الأحصائى وجود اختلافات مؤكدة فى كمية حامض الايدروسيانيك بين النباتات الطازجة وبعد تعريضها لأشعة الشمس .

(*) قسم الانتاج الحيوانى « فرع تغذية الحيوان » بكلية الزراعة ـ جامعة القاهرة ـ بالجيزة .