

## ***Lathyrus Sativus* L. (Chickling Vetch ; Khesari ; Indian Pea) as a Stock Food.**

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### **INTRODUCTION.**

ON 15/5/31, a letter, in which information was sought as to the suitability of *Lathyrus sativus* L. hay as cattle feed, was received at Onderstepoort from the Cotton Breeding Station, Barberton. Specimens of this plant were submitted at the same time.

*Lathyrus sativus* L. (National Herbarium No. 11766 ; Onderstepoort Specimen No. 1388, 5/6/31) was grown at Barberton and it was noticed that it was not attacked by the numerous pests which were prevalent on the other winter crops grown at the above station. This phenomenon was mainly responsible for the interest taken in *Lathyrus sativus* as a stock feed.

This plant is stated (see Review of Literature) to have been responsible for losses in stock in various parts of the world, but as the toxicity of the same plant grown in different localities varies to a considerable extent, it was thought advisable to find out whether the plant grown under South African climatic and soil conditions was poisonous and, if so, to determine the degree of toxicity.

### **REVIEW OF LITERATURE.**

*Lathyrus sativus*, *L. cicera* and *L. clymenum* are used as articles of diet in India and Algeria, and both the plant (hay) and peas are grown on a large scale in Canada, Southern Europe, Algeria, and India as food for cattle, horses and other stock. Many cases of poisoning in human beings and stock due to the ingestion of these peas in large amounts are on record.

Pammel (1911) mentions that *Lathyrus cicera*, *L. clymenum* and *L. sativus* are poisonous and that the active principles are unknown.

Long (1917) refers to *Lathyrus cicera*, *L. clymenum* and *L. sativus* as having caused poisoning in man, horses, cattle, sheep and pigs, particularly in horses. Many cases of poisoning have been recorded in the veterinary journals since 1885. In 1884 *Lathyrus sativus* caused death in nineteen out of thirty-five affected horses, which took ill through eating these peas at the rate of three to four lb. per head per day. Long quotes another case where *Lathyrus sativus* caused poisoning in a hundred and twenty-three out of eight hundred horses. Few cases of *Lathyrus*-poisoning in other classes of stock are recorded. Pigeons are stated to become partly paralysed and unable to fly. When boiled the peas lose part of their toxicity as the toxic substance passes into the water, which may contain such amounts of poison as to cause death.

Fröhner (1919) mentions that the information with regard to the toxicity of *Lathyrus cicer* (*N.B.* not to be confused with *Lathyrus cicera*) is very contradictory. Apparently this plant, which has always been considered as a valuable food for human beings and stock, has sometimes been confused with *Lathyrus sativus* and hence the records of its toxicity.

Anderson, Howard and Simonsen (1925) thoroughly investigated the toxicity of *Lathyrus* in an attempt to clear up the contradictory statements as to its harmfulness to human beings and stock. They obtained *Lathyrus sativus* seeds from thirty localities and found the only contaminating seed to be that of *Vicia sativa* L. var. *angustifolia*. These seeds were sown and it was soon evident that the "khesari" from the various localities were not identical. Further investigations proved that in addition to *Vicia sativa* the following plants may be found as weeds on *Lathyrus* fields: *Lathyrus sphaericus* Retz., *Lathyrus aphaca* and *Vicia hirsuta* Koch. Both the feeding trials and chemical examination of these three weeds yielded negative results.

The experiments of Anderson, Howard and Simonsen with *Lathyrus sativus* gave negative results, whilst with *Vicia sativa* they produced symptoms of poisoning in ducks and monkeys resembling those ascribed to *Lathyrus sativus*. These authors state that their experiments indicate that "khesari" is harmless and that the danger of disease lies in its contamination with *Vicia sativa*. They suggest the prevention of lathyrism by sowing the lathyrus seeds in rows one foot apart so as to allow of proper weeding in the early stages of growth.

Clough (1925) gave a very useful historical summary of *Lathyrus* poisoning.

Lander (1926) states that *Lathyrus sativus*, *L. vicia* and *L. clymenium* are harmless in the early stages of growth and that the toxicity sets in from the time of the formation of seed, the seeds being the most dangerous part.

Stockman (1929) produced *Lathyrus* poisoning in monkeys by feeding them on steamed *Lathyrus* peas. Rabbits fed on steamed *Lathyrus* peas for five months developed no symptoms. All guinea pigs fed on the steamed peas died after eight to thirty-five days, the cause of death being inanition.

#### A. THE TOXIC PRINCIPLE.

At the Imperial Institute (Editorial 1917) the seeds of several forms of *Lathyrus sativus* obtained from India, Cyprus and Canada have been chemically examined but no toxic constituents could be isolated.

Long (1917) remarks that Smith (Bernhard-Smith) gives the active principle of *Lathyrus* as prussic acid and the former rightly disagrees as the symptoms of *Lathyrus* poisoning by no means resemble those of prussic acid poisoning. Fröhner (1919) mentions that nothing definite is known about the chemical nature of *Lathyrus* poison, and that it probably is an alkaloidal substance. Byam and Archibald (1921) state that the causative principle is not known.

Bernhard-Smith (1923) states that the toxic principle of *Lathyrus vicia* and *L. clymenium* is prussic acid. This incorrect statement was referred to by Long.

Anderson, Howard and Simonsen (1925) mention that Stockman and Dilling extracted from the seeds of *Lathyrus sativus* small amounts of alkaloidal substances, which on subcutaneous inoculation into animals produced symptoms similar to those of *Lathyrus* poisoning. On the other hand Acton and Chopra maintain that an amine is responsible for the toxicity of *Lathyrus sativus*, while other investigators could find no traces of poisonous bases in the various *Lathyrus* spp. examined by them.

Anderson and his co-workers could find no alkaloids in the unripe and ripe seeds of *Lathyrus sativus* and consider that the alkaloids isolated by Stockman and Dilling were contained in extraneous seeds contaminating the samples of *Lathyrus sativus* used in their investigations.

Stockman (1929) mentions that in a publication of 1917 he isolated a poisonous alkaloid from the seeds of *Lathyrus sativus* and that Dilling isolated two poisonous alkaloids from the seeds of this plant. In his 1929 publication Stockman states that the active principle of *Lathyrus* is soluble in cold water, acidified water, weak and 90 per cent. alcohol, and chloroform. In his 1931 publication Stockman withdraws his statement made in 1917 that the active principle of *Lathyrus sativus* is of an alkaloidal nature and now states that, according to his investigations, the toxic constituent of *Lathyrus sativus* grown in India and *L. cicera* grown in France is an acid. He has succeeded in isolating a poisonous acid also from *Ervum ervilia* L. (bitter vetch), *Ervum lens* (lentils), *Pisum sativum* (common pea), *Soya hispida* (soy bean), *Vicia sativa* (tares) and *Cajanus indicus* (pigeon pea). He states that the poisonous acid in these beans is probably the same.

## B. SYMPTOMS.

*Lathyrus* is derived from the Greek word "Lathyros" meaning vetchling. "Lathyros" is stated to have its root in a Greek word meaning exciting and impetuous. Greek and Roman agricultural history refers to the stimulant properties of pulses for man and domestic animals.

*Human beings*: Poisoning is of most frequent occurrence in young men; women, children and elderly men are less susceptible. The increased susceptibility of the former is supposed to be due to exposure to cold and wet weather and fatigue.

It rarely happens that prodromal symptoms of pain, numbness, cramps and prickling are experienced, the most common course of the disease being a sudden onset of weakness and heaviness in the legs and loins. Walking is impaired, reflexes are increased, the muscles tremble when weight is put on them. If the consumption of *Lathyrus* is not discontinued, paralysis will progress until the patient is unable to walk. The arms are rarely affected in the same way as the legs. Convulsive movements of the upper and lower limbs and painful contractions of the muscles are experienced.

Post-mortem appearances: Pronounced atrophy of the spinal cord. Histological examination reveals disappearance of cells in the affected portion of the nervous system and increase in neuroglia (the picture resembling that of a recovered case of myelitis transversa) (Petri, 1930).

The affected muscles are atrophied and show fatty degeneration.

*Domestic animals*: The symptoms in domestic animals to a very large extent resemble those exhibited by human beings, weakness and paralysis of the hindquarters being the most common symptom. In horses which are the most susceptible of our domestic animals, "roaring" is frequent, which is caused by paralysis of the nervus recurrens and acceleration of the pulse, due to incipient paralysis of the vagus centre. Prodromal symptoms of excitement may occur. Death usually follows after months of illness with symptoms of asphyxia.

Bovines exhibit symptoms similar to those seen in horses except "roaring." They show suspended rumination, constipation, paralysis of the limbs, small and weak pulse and loss of sensibility in the skin. Monkeys are affected in the same way as human beings.

Sheep, pigs, dogs, ducks, geese, peacocks and pigeons all develop weakness and paralysis with their accompanying symptoms.

#### C. POST-MORTEM APPEARANCES AND HISTOLOGY.

There is atrophy of the larynx muscles and degenerative changes in the ganglion cells of the spinal cord and vagal and accessory nuclei of the medulla. Thickening of the walls of the arterioles and capillaries in the spinal cord and degeneration of the myocard have been described.

In the horse the following lesions were found: congested patches in the stomach and intestines, hyperaemia of the lungs and catarrhal bronchitis; and in cattle: thick and dark blood, a large amount of bloody serum in the cranium and anterior portions of the spinal canal, pronounced congestion of the meninges with haemorrhagic patches.

#### D. TREATMENT.

Feeding of the *Lathyrus spp.* must immediately be discontinued. Medicinal treatment may consist of applying stimulants to the central nervous system (strychnine) and irritants (mustard plasters, etc.) to the skin along the spinal column.

#### **ONDERSTEEPOORT EXPERIMENTS.**

As *Lathyrus sativus* appeared to be less susceptible to pests attacking other winter crops, there was a possibility of its being extensively grown in South Africa as a winter feed for stock. It was for this reason that it was decided to ascertain the toxicity (if such existed) of this plant in all its stages of development, both in the fresh and dried state. Unfortunately, owing to the enforcement of stringent economic measures it was possible only to conduct feeding experiments with the plant in the fresh state and preflowering and flowering stages.

Horses, cattle, sheep and rabbits were used in these experiments. These animals were offered daily the freshly cut plant without any additional ration and every twenty-four hours after feeding the remaining quantities of plant material were weighed so as to calculate the amount of plant eaten in twenty-four hours. The amounts of plant recorded in the table given below are approximate as in feeding experiments there unavoidably is a certain error in the difference of the weights of the fresh succulent plant fed and the remaining quantity weighed twenty-four hours after feeding owing to loss of moisture and wastage during feeding. It is obvious that the more succulent the plant is and the slower the ingestion, the greater this error will be.

The material fed consisted of a mixture of the plant in the preflowering and flowering stages.

The results of the above experiments are recorded in the following table :—

TABLE I.  
*LATHYRUS SATIVUS* FEEDING EXPERIMENT.

Animal and D.O.B. No.	Age.	Weight at beginning of experiment.	Weight at end of experiment.	Average quantity of plant eaten daily.	Period of feeding.	Total quantity of plant consumed.	Result.
4 rabbits....	Fullgrown	Kg. 2.1 2.8 2.4 2.3	Kg. 2.0 2.7 2.5 2.4	Kg. 1.145	Days. 89	Kg. 102	On the third day of the experiment one rabbit was found lying with its head resting on the cage floor. It was unable to lift the head or sit up or move about and died at 4 p.m. the same day. <i>Post-mortem appearances :—</i> Slight hyperaemia of lungs. All other organs appeared normal. It was substituted by another fullgrown rabbit. The remaining rabbits developed no symptoms.
2 rabbits....	Fullgrown	2.8 2.6	2.9 2.9	1.183	71	84	Remained healthy.
2 rabbits....	Fullgrown	2.7 2.6	2.8 2.5	1.270	63	80	Remained healthy.
Sheep 29652..	Fullmouth	33.0	34.0	4.76	55	262	Remained healthy.
Sheep 23555..	Fullmouth	45.0	46.0				
Horse 18237..	Aged.....	—	—	3.26	35	114	Died on 38th day of the experiment.
Horse 18526..	Aged.....	—	—	3.85	55	212	Developed symptoms of poisoning but recovered.
Ox 3636.....	± 2 years	273	298	26.86	22	591	Remained healthy.
Heifer 4199..	± 2 years	245	248				

All the animals, with the exception of the horses which did not take the plant readily the first few days of the experiment, ingested the plant with eagerness throughout the period of experimentation.

#### RABBITS.

Of a group of four rabbits which ingested the plant at the rate of 1.145 Kg. daily, one animal showed a sudden onset of paralysis on the third day of the experiment and died the same day. The post-mortem revealed nothing but a slight hyperaemia of the lungs. Whether this rabbit possessed an idiosyncrasy for *Lathyrus* poison or died from some other cause, is difficult to say. The remaining eight rabbits remained in a perfect state of health in spite of the fact that they ingested large amounts of the plant over prolonged periods.

## LATHYRUS SATIVUS L. AS STOCK FOOD.

### SHEEP.

Two sheep consumed 262 Kg. of the plant in fifty-five days without showing any ill-effects.

### HORSES.

The average daily amount of plant ingested by the horses is small as compared with that ingested by the other animals owing to the fact that very little of it was taken from the time the horses developed symptoms of poisoning.

From the second week of the experiment both horses steadily lost in condition, and from the twenty-fifth day they showed an increase in the pulse rate and a fairly profuse diarrhoea. Five days later diarrhoea still persisted and both animals showed pronounced weakness of the hindquarters, dirty brown conjunctiva with a yellowish tinge, and laboured respiration. Horse 18237 appeared much worse than 18526, the former showing progressive paralysis. On the thirty-second day of the experiment it made repeated attempts to rise but without success. It was repeatedly seen sitting up like a dog. Its condition was poor, respiration laboured, pulse weak and accelerated and the conjunctiva dirty yellowish brown and showed ecchymoses. The animal yawned frequently and at times made chewing movements. In the course of another two days the animal was completely paralysed, the prominent parts of the body showing abrasions due to struggling. Death occurred on the thirty-fifth day of the experiment after the animal had ingested 114 Kg. of the plant.

*Post-mortem appearances* : Abrasions on all prominent parts of the carcass ; intense general icterus ; hyperaemia of the lungs ; subepicardial haemorrhages ; pigmentation and degenerative changes in the liver ; blood not coagulated and tarry in consistence ; gastrophilus larvae in stomach ; impaction of caecum, which contained a large amount of grit ; chronic catarrhal enteritis.

*Histology* : Dr. G. de Kock, Head of the Department of Pathology, Onderstepoort, who examined the specimens collected from horse 18237, reported that no specific changes were seen in the organs. The liver and kidneys showed hyperaemia.

Horse 18526, which received 212 Kg. in the course of fifty-five days, developed the same train of symptoms. It showed pronounced weakness of the hindquarters and was frequently seen supporting its balance by leaning against the stable wall. As no more plant material was available, the feeding had to be discontinued with the result that improvement set in, the animal appearing quite normal a month after discontinuation of the feeding.

### CATTLE.

Two young bovines ingested 591 Kg. of *Lathyrus sativus* in twenty-two days without having suffered any ill-effects.

In the following table are recorded the results\* of a chemical examination of *Lathyrus sativus* :—

TABLE II.

Nature of plant material.	Origin of plant material.	Ash.	P <sub>2</sub> O <sub>5</sub> .	CaO.	Fat.	Cellulose.	Protein.	Moisture content.
Fresh green plant in flowering stage	Onderstepoort	% 6.0	% 0.51	% 1.08	% 4.47	% 36.6	% 17.3	% 74.5 air dried.
Hay (flowering and seeding plant)	Cotton Breeding Station, Barberton	8.0	0.34	0.96	2.4	27.0	20.9	8.3
Seed (ripe).....	Cotton Breeding Station, Barberton	2.9	0.74	0.24	0.6	—	28.0	10.0

\* I am indebted to Mr. D. J. R. van Wyk of the Division of Chemistry, Department of Agriculture, Pretoria, for these analyses.

With regard to the protein and fat content of *Lathyrus sativus* it has a feeding value equal to, if not better than other vetches.

#### DISCUSSION.

The first question that arises is whether *Lathyrus sativus* is poisonous or not. As botanical identifications are by no means perfect, it is highly probable that the various investigators in the different parts of the world have been working with different species or varieties of *Lathyrus*, which were all identified as *Lathyrus sativus*. As consignments of seeds were forwarded to some investigators the probability of these consignments containing seeds other than those of *Lathyrus sativus* is even greater, unless such seeds were collected by a competent person from properly weeded lands. It is therefore clear that it is of the utmost importance to preserve specimens of all plants used in experiments in order to be able to compare such plants with those about whose identity doubt may arise at a future date.

There is also little doubt that the contradictory results recorded in the literature were due, at least partly, to the various consignments of seeds being obtained from the plant grown in different parts of the same country or even different countries as it is a well established fact that the same plant grown in different localities may vary in toxicity to a considerable extent.

The plant grown at Onderstepoort from seed obtained from the Cotton-Breeding Station, Barberton, was identified as *Lathyrus sativus* by the Division of Botany, Pretoria, and specimens of this plant are being kept in the National Herbarium, Pretoria (No. 11766) and at the Onderstepoort Herbarium (O.P. Spec. No. 1388; 5/6/31). It must be mentioned that at Onderstepoort the *Lathyrus sativus* seeds were planted in rows eighteen inches apart which allowed of proper weeding and at no time was the material fed contaminated with any extraneous plants.

Onderstepoort experiments have proved beyond doubt that this plant grown at Onderstepoort in the period May-December, 1931, and in the state and stages in which it was used in the experiments, was poisonous to horses, causing death in one and serious symptoms of poisoning in another. The symptoms exhibited by these two animals were identical with those described in the literature in *Lathyrus sativus* poisoning, with the exception of the general icterus found in the Onderstepoort cases. Also no "roaring" was present in the Onderstepoort cases.

Another point which coincided with information supplied in the literature is that horses are the animals most susceptible to *Lathyrus sativus* poisoning. Rabbits, sheep and bovines have consumed relatively much larger amounts of the plant grown at Onderstepoort than horses and have suffered no ill-effects. Not only did the plant cause no damage to the health of these animals but it apparently supplied all the food requirements essential for growth and maintenance of health.

The fact that *Lathyrus sativus* is poisonous when fed in large amounts and without any additional ration, does not preclude its use as a stock feed and as a part of the daily human diet. Experiments have proved, and this has been corroborated by numerous observations made in India and other countries, that *Lathyrus sativus* seeds can form part of the daily diet of man and animal with very beneficial results, provided moderate amounts are taken.

With regard to the nature of the toxic principle of *Lathyrus sativus* confusion exists as in the case with information concerning whether it is toxic or not. The same reasons, that have been given for the contradictory information in connexion with the toxicity of the plant, may be advanced here.

Some investigators have failed to isolate any toxic principle from this plant, whilst others state it to be prussic acid, a substance of alkaloidal nature, an amine and an acid respectively.

#### SUMMARY.

*Lathyrus sativus* grown at Onderstepoort and fed without any additional ration in the fresh state and in the preflowering and flowering stages proved to be poisonous to horses. Cattle, sheep and rabbits, although having consumed relatively larger amounts of the plant, suffered no ill-effects.

No definite results with regard to the active principle of *Lathyrus sativus* have been achieved by the various investigators.

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