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The Toxicity of Oil of Turpentine for Domestic Animals.

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I. Introduction.

As a number of cases of suspected poisoning in stock with oil of turpentine has been reported to us in the course of the last few years the information in this article may be of value to those concerned.

Latterly serious mortality occurred in horses and donkeys which had been drenched by means of a bottle with the following mixture:—

" 4 oz. of oil of turpentine,
1 drachm of extract of male fern,
1 pint of raw linseed oil."

This mixture was prescribed by one of our Government Veterinary Officers and the owner of the animals alleged that the quantity of oil of turpentine is excessive and had caused the mortality among his animals. Half-doses were prescribed for young animals.

II. Nature of Oil of Turpentine.

Oil of turpentine is a colourless, clear liquid with a peculiar odour and a pungent, somewhat bitter, taste obtained by distillation and rectification from turpentine.

Turpentine is an oleo-resin obtained from various species of *Pinus* growing in different parts of the world.

Oil of turpentine contains various hydrocarbons (terpenes), like carene, pinene ($C_{10}H_{16}$) and camphene, and resin acids.

" Aleppo turpentine " is obtained from *Pinus halepensis*.

" Bordeaux turpentine " is obtained from *Pinus maritima*. It is known as " galipot ".

" Canada turpentine " is also obtained from *P. maritima*.

" Carpathian turpentine " is obtained from *Pinus cembra*.

" Chian turpentine " is obtained from the Mediterranean tree, *Pistacia terebinthus*.

" Common or white turpentine " is obtained from different species of *Pinus*.

" Hungarian turpentine " is obtained from *Pinus pumilio*.

" Larch or Venice turpentine " is obtained from the larch tree, *Larix europea*. It is a viscid liquid of a yellowish or yellowish-green colour.

" Strassburg turpentine " is obtained from the European spruce or fir tree, *Abies pectinata*.

It should be mentioned that in commerce there is a *turpentine substitute*, called " white spirit ", with a boiling range from 140° to 220° F., whilst true oil of turpentine boils at about 312·8° F. " White spirit " is a distillation product of petroleum and is probably more poisonous than oil of turpentine, as it is more volatile.

Petroleum, resin oil and wood turpentine are the most common adulterants found in oil of turpentine. Wood turpentine is obtained by distilling the roots and stumps of various species of *Pinus*.

Furthermore petroleum, paraffin oils, rosin, rosin oil, petroleum benzin, kerosene oil and similar hydrocarbons may occur as impurities in oil of turpentine.

Oil of turpentine should be stored in well-closed containers (preferably dark-coloured ones) in a cool and dark place. In light and in the presence of oxygen oxidation processes cause the formation of formic, acetic and camphoric acids, camphoric aldehyde, and hydrogen peroxide.

Oil of turpentine should have a residue of not more than 0·5 per cent. when evaporated quickly in a flat dish over a water-bath.

[British Pharmac. Codex (1934); Dorland (1923), Squire (1916).]

III. Toxic Doses.

The toxic doses of oil of turpentine vary according to its origin, chemical constitution, and storage. The more volatile the constituents and the higher the degree of oxidation of these constituents the more poisonous the oil of turpentine will be. The presence of impurities like paraffin oils, petroleum benzin, kerosene oil and other volatile hydrocarbons renders oil of turpentine more toxic.

Fröhner (1919) states that horses and cattle tolerate single doses of 250 to 400 grams (= ±8 to 13 oz.) of oil of turpentine, whilst amounts of from 500 to 1,000 grams (= ±17 to 33 oz.) induce colic, diarrhoea and haematuria in horses. He saw a pronounced haemorrhagic nephritis in a horse which had received 500 grams of oil of turpentine. The animal, however, recovered. Hertwig (Fröhner, 1919) reports that dogs, which had received from 8 to 30 grams (= ± ¼ to 1 oz.) of oil of turpentine died from gastro-enteritis.

A child died about fifteen hours after having swallowed 15 grams of oil of turpentine (Lewin, 1929). Leschke (1932) states that 10 to 15 c.c. of oil of turpentine is poisonous for man, persumably when taken undiluted. The British Pharmaceutical Codex, 1934, prescribes 8 to 16 c.c. (=2 to 4 fluid drachms) of oil of turpentine as an anthelmintic for man.

Dierschke (1935) accidently injected three horses weighing approximately 700 Kg. intravenously with 15 c.c. of oil of turpentine. Each injection was completed in fifteen seconds. Within a few minutes after injection two of the horses developed the following symptoms of poisoning: restlessness, shaking the head, perspiration, accelerated pulse and respiration, one animal developed an irregular pulse and did not feed. The temperatures recorded were from 39·4 to 40·0° C. The third horse also showed similar symptoms within a few hours after the injection. The following morning the animals appeared normal again.

Jeckowitsch (Dierschke, 1935) injected one hundred horses suffering from laryngo-pharyngitis intravenously with 3·0 c.c. of oil of turpentine with very satisfactory results. Horses, which had received 2·0 c.c. of oil of turpentine intravenously five times at intervals of from four to six days developed no symptoms of poisoning [Scharangowitsch (Dierschke, 1935)].

Dierschke suggests that experiments be conducted in order to ascertain the toxic doses of oil of turpentine when injected intravenously as this method of administering this aetherial oil may prove of great benefit in diseases of the respiratory tract.

When injected subcutaneously oil of turpentine causes the formation of sterile abscesses.

Onderstepoort Experiments.

As mixtures of oil of turpentine, extract of male fern and raw linseed oil are commonly used as anthelmintics in horses it was thought advisable to administer both oil of turpentine and extract of male fern in the same mixture in order to ascertain whether they act synergistically and increase each others toxicity.

The oil of turpentine used in these experiments is that prepared by Riedel and de Häen, Hannover, Germany, except where stated otherwise.

The extract of male fern used bears the following label: " Extract Ethere de Fougére Mâle Vétérinaire, Titre 24-25 per cent. filicine brute. Gignoux Freres & Cie, Lyon ".

The raw linseed oil was the " Genuine Raw Linseed Oil, Thistle Brand " obtained from W. McIntosh, 473 Church Street, Pretoria.

All the horses were starved for approximately eighteen hours before being drenched; they, however, had free access to water.

ONDERSTEPOORT EXPERIMENTS.

Animal.	Age and condition.	Weight.	Quantity of oil of turpentine administered per stomach tube.	Result.
Rabbit A....	Full-grown and in good condition	2·0 kg.	4·0 c.c. of oil of turpentine* in 33 c.c. of raw linseed oil	Not feeding well for ± 36 hours after drenching and slight diarrhoea set in ± 24 hours after drenching and lasted approximately 12 hours. Thirty-six hours after administration of the oil of turpentine the animal was normal again.
Rabbit B....	Full-grown and in good condition	2·25 kg.	8·0 c.c. of oil of turpentine* in 50 c.c. of raw linseed oil	Severe diarrhoea set in within 12 hours after drenching and lasted for four days. During this period the animal did not feed, was very apathetic, and lost in condition. Respiration and pulse were accelerated. Diuresis was present. Recovery took place five days after drenching.
Horse 21413	Gelding in fairly poor condition	—	(1) 120 c.c. (= 4 oz.) of oil of turpentine* and 4·0 c.c. (= 1 drachm) of extract of male fern in 600 c.c. (= 1 pint) of raw linseed oil on the 25/8/36	The animal suffered no ill-effects.
			(2) 120 c.c. of oil of turpentine and 8·0 c.c. of extract of male fern in 600 c.c. of raw linseed oil on 16/11/36	The animal suffered no ill-effects.
			(3) 240 c.c. of oil of turpentine and 8·0 c.c. of extract of male fern in 600 c.c. of raw linseed oil on 15/12/36	On the 16/12/36 and 17/12/36 the animal passed partly undigested soft faeces and was not feeding well. On the 18/12/36 diarrhoea and diuresis were present, but the animal appeared quite healthy and was feeding well. On the 19/12/36 the faeces were normal again.

ONDERSTEPOORT EXPERIMENTS—(*continued*).

Animal.	Age and condition.	Weight.	Quantity of oil of turpentine administered per stomach tube.	Result.
Horse 21357	Aged gelding in fair condition	—	(1) 120 c.c. of oil of turpentine and 4·0 c.c. of extract of male fern in 600 c.c. of raw linseed oil on 16/11/36 (2) 120 c.c. of oil of turpentine and 4·0 c.c. of extract of male fern in 600 c.c. of raw linseed oil on 15/12/36	The only noticeable symptoms were that the animal was off its feed for about three hours and the faeces slightly soft in consistence during the day after drenching. Fairly severe diarrhoea, diuresis and loss of appetite, lasting for about two days, set in about twenty-four hours after drenching. Complete recovery had taken place on the fourth day after drenching.
Horse 21358	Aged mare in fairly good condition	—	(1) 120 c.c. of oil of turpentine and 4·0 c.c. of extract of male fern in 600 c.c. of raw linseed oil on 16/11/36	Suffered no ill-effects whatsoever.
			(2) 240 c.c. of oil of turpentine and 4·0 c.c. of extract of male fern in 600 c.c. of raw linseed oil on 15/12/36	Results similar to that described under (2) of Horse 21357.
Horse 21415	Aged stallion in poor condition	—	120 c.c. of oil of turpentine and 8·0 c.c. of extract of male fern in 600 c.c. of raw linseed oil on 16/11/37	Suffered no ill-effects whatsoever.

* Prepared by Merck, Darmstadt, Germany.

From the foregoing experiments it is evident that 8·0 c.c. of oil of turpentine administered in 50 c.c. of raw linseed oil induced transient symptoms of poisoning in a rabbit, while 4·0 c.c. administered in 30 c.c. of raw linseed oil caused a slight diarrhoea and temporary loss of appetite.

It would appear that 120 c.c. (=4 oz.) of oil of turpentine and 4 c.c. (=1 drachm) of extract of male fern administered in 600 c.c. (=1 pint) of raw linseed oil is a safe mixture for full-grown horses in fairly good condition. Horse 21413 even tolerated twice this quantity of oil of turpentine and extract of male fern without showing definite symptoms of poisoning. In view of the fact, however, that horse 21357 reacted fairly severely to a mixture of 120 c.c. of oil of turpentine and 4 c.c. of extract of male fern in 600 c.c. of raw linseed oil it would not be advisable to administer larger quantities than these of oil of turpentine and extract of male fern to full-grown horses in fairly good condition. Horses in poor condition and young horses should receive half of the above doses, or less, according to age, size and condition. The prescribed dose of 120 c.c. of oil of turpentine is that for the pure, unoxidised and unadulterated product. The oxidised and adulterated oil containing kerosene oil, benzine, paraffin, etc., will probably be more toxic.

IV. Symptoms of Poisoning.

Oil of turpentine is a severe irritant to the skin and mucous membranes. It is, therefore, obvious that it should not be administered as such *per os* but be mixed with demulcents and emollients. As a rule it is administered in raw linseed oil. It is known to have caused immediate death when administered as such *per os*, death being due to choking owing to the irritant nature of the oil.

Given internally in toxic doses it causes stomatitis, laryngitis, pharyngitis, and acute catarrhal gastro-enteritis.

It is excreted to a large extent by the lungs and kidneys. In acute poisoning the exhaled air smells of the oil. Large doses of oil of turpentine cause an acute nephritis, which may be haemorrhagic, and also pyelitis and cystitis.

The central nervous system is also affected. At first there is stimulation manifested in increased reflexes, muscular tremors, spasms, excitement, palpitation of the heart, accelerated pulse and dyspnoea. These symptoms are followed by those of paralysis, namely apathy, dizziness, staggering, fall in blood-pressure, heart-weakness, general paralysis, slowing, and eventually paralysis of the respiration.

If oxidation of the oil of turpentine had occurred it may cause methaemoglobinaemia. According to Winternitz (Petri, 1930) there may be a pronounced leucocytosis in cases of poisoning with oil of turpentine.

The urine has a characteristic violet-like odour.

As in mercurial poisoning death may be a sequel to the nephritis caused by oil of turpentine.

If excessive quantities of oil of turpentine are inhaled it will cause bronchitis and pneumonia in addition to the above symptoms.

V. Post-Mortem Appearances.

In cases of acute poisoning with oil of turpentine general cyanosis, nephritis, and severe irritation of the gastro-intestinal mucosa will be seen. There is hyperaemia of all the internal organs. Oil of turpentine is detectable in the thoracic cavities and stomach contents by means of its characteristic odour.

In cases of chronic poisoning there may be nephritis and chronic gastro-enteritis.

VI. Contra-indications.

Oil of turpentine should not be administered to animals suffering from congestion of the kidneys, nephritis, or gastro-enteritis.

VII. Treatment.

No specific antidote to oil of turpentine is known and symptomatic treatment is to be applied. If possible stomach lavage should be applied. Emollients, demulcents and astringents (barley gruel, linseed decoctions, raw linseed oil, lime water, tannic acid) and general heart stimulants (caffeine) should be administered.

In cases where paralysis has already set in central nervous system stimulants (strychnine, caffeine) and respiratory stimulants (lobeline) should be given.

VIII. Summary and Conclusions.

1. The following mixture appears to constitute no danger to full-grown horses not suffering from congestion of the kidneys, nephritis or gastro-enteritis: —

" 120 c.c. (=4 oz.) of oil of turpentine,
4 c.c. (=1 drachm) of extract of male fern,
600 c.c. (=1 pint) of raw linseed oil ".

As stated before young animals and animals in poor condition should receive half of this mixture, or less, and only pure unadulterated and unoxidised oil of turpentine should be used.

2. Experiments conducted at Onderstepoort with oil of turpentine and extract of male fern are described.

3. The toxic doses, symptoms of poisoning, post-mortem appearances, and treatment of cases of oil of turpentine poisoning are discussed.

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