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AVERSIVE CONDITIONING BLACK BEAR TO HONEY UTILIZING LITHIUM CHLORIDE

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ABSTRACT

Seven caged black bear *(Ursus americanus)* were fed granular lithium chloride mixed in honey. At the maximum dosage (80g dissolved in .9 l of honey) and minimum dosage (20g/.9 l) ingestation resulted in sickness. A single treatment resulted in six of the treated bears being conditioned to refuse to eat pure honey for periods varying from 15 to 220 days. One bear continued to relish pure honey and exhibited no aversion

INTRODUCTION

A major management problem with the remaining black bear *(Ursus americanus)* population in Georgia exists because much of the beekeeping and honey industry in the state is located in the remaining bear habitat and because of the strong attraction that bear have for honey. Many beekeepers who maintain bee yards in bear territory utilize protective devices such as electric fences, blinking lights, transistor radios and guard dogs to minimize attacks of bear on hives; however, the most efficient device is the bear proof beehive platform (Whisenhunt, 1958); however, the platform is not used extensively in Georgia due to initial construction cost and working inconvenience.

Serious conflicts arise between game managers and beekeepers when a few beekeepers revert to protection of their hives by killing bears with honey containing strychnine or the aid of steel traps and "catch-and-tree" dogs. The problem is exemplified by a bill introduced in 1975 into the Georgia House of Representives making the State of Georgia liable for bear damage to beehives under certain conditions and giving the beekeeper the right to destroy bears under certain conditions (Georgia, 1975). The bill is still pending.

The purpose of this research project was to determine if lithium chloride could be used effectively and safely to cause aversive reaction of bear to honey at prescribed dosage levels. Gustavson and Garcia (1974) used this material to avert coyote *(Canis latrans)* predation of sheep and mountain lion *(Felis concolor)* taste for "deer-burger".

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METHODS

Materials and Preparations

Lithium chloride is a white granular compound very similar to sodium chloride in texture and taste. It is highly water soluble and hygroscopic. Since heat is generated when the compound dissolves in water it is necessary to use containers not easily melted.

Each dosage of lithium chloride was weighed in grams using portable scales and was stored in a air-tight plastic container prior to final mixing. In 6 tests immediately before treatment, water was added to the lithium chloride dosage until all granules were complete dissolved. The water was added in small portions and the mixture was stirred continuously so as to minimize the amount of water needed. The solution was then thoroughly mixed with .9 l of strained gallberry honey. In one test the lithium chloride was mixed directly into the honey; however, even with vigorous stirring and addition of water, the lithium chloride could not be dissolved.

Dosage Levels

Information regarding appropriate dosage levels was very limited. Gustavson and Garcia (1974) used 6 g to treat a coyote. Assuming a standard weight of 22.7 kg. for coyotes, a proportionate amount of lithium chloride was used per 22.7 kg of bear weight for the dosage level (Table 1). Since very rough estimates for bear weights were made, dosages were rounded to the nearest 10g. The only exception to this dosage level was for the test bear Oakey. Because he was nearly 20 years old and somewhat feeble, his dosage level was reduced to 50 percent of standard.

Table 1. Dosage levels of lithium chloride treatments.

Bear	*Weight*	*Dosage*	*Reaction to Treatment*	*Reaction Time*
Hubert	350 lb.	40 g in .9 l	Sickness	1 hr. 40 min.
Blackjack	700 lb.[1]	80 g in .9 l	Sickness	48 min.
Oakey	300 lb.	20 g in .9 l	Sickness[2]	30 min.
June	150 lb.[3]	20 g in .9 l	Sickness	2 hr. 45 min.
Mitch	300 lb.	40 g in .9 l	Sickness	50 min.
Black Ben	350 lb.	40 g in .9 l	Sickness	1 hr. 55 min.
Rosemary	300 lb.	40 g in .9 l	Sickness	55 min.

[1] Less than one-fourth dosage consumed
[2] Did not disgorge stomach contents
[3] Approximately one-half dosage consumed

Experimental Animals

The test animals used were caged black bears located at Okefenokee Swamp Park, Waycross, Georgia, Tift Park Zoo, Albany, Georgia, and the Alabama Wildlife Research Area, Prattville, Alabama. The bears are used for zoological displays and have been confined for several years. The staple diet of the bears was dried dog food, some fruits, vegetables and various sweets were also being fed.

Pre-Conditioning

Honey had been fed to six of the test animals and was readily accepted. One bear, located at Tift Park Zoo, had not received honey frequently enough in its diet to be certain of its acceptance of honey; therefore, for one week prior to treatment honey was fed daily to the test animal. The honey was accepted readily each day.

Presenting the Treatment

In initial tests, the treatment dosage was offered to the test animal in the lower half of a plastic gallon milk carton. Since the carton was usually overturned in a matter of seconds, later dosages were either poured on a concrete slab or a sheet of tin. The time required for each bear to ingest the treated honey and the time interval between ingestion and sickness was recorded. After the initial treatment each bear was offered pure honey one to two weeks later and periodically thereafter. Reactions of acceptance or refusal were recorded.

RESULTS AND DISCUSSION

Acceptance of Emetic Dosage

Of the seven bears offered the dosage of honey mixed with lithium chloride, five consumed the entire dosage. One bear, Blackjack, consumed less than .45 l and a second bear, June, consumed approximately .45 l (Table 1). Several factors may have been responsible for Blackjack's action. He was given a dosage of 80g while the other bears received either 20 or 40g. Since the taste of lithium chloride is similar to sodium chloride, the dosage may have been too salty. Also, the lithium chloride in this dose was not first dissolved in water and it would not dissolve in the honey. Pure lithium chloride crystals touched to my tongue produced a very hot sensation. This sensation probably was also experienced by Blackjack when he began to eat his treatment dosage. No plausible explanation can be given for June's reaction. All seven bears used in the test appeared to find the "spiked" honey less desirable than pure honey.

Symptomology

Each of the seven bears that consumed the lithium chloride dosage regurgitated or showed other overt signs of sickness (Table 1). Only one bear, Oakey, did not disgorge. This could possible be explained by the fact that a 20g dosage was administered to him while other bears in the same weight range received 40g treatments. The minimum and maximum times from ingestion to visible symptoms of sickness were 30 minutes and 2 hours and 45 minutes, respectively.

Symptoms of sickness in the test bears were similar to symptoms exhibited by humans who received over-doses of lithium during mood therapy (Gattozzi, 1970). His description — "the syndrome consists of some particular bilious feeling, something like a cross between seasickness and a hangover," would be an accurate one if bears can get seasick and intoxicated at the same time. Overt symptoms of sickness in the bears included restlessness, swaying of the head, tears flowing from the eyes, frequent urinating and drinking of water, salivating and flexing tongue and mouth and regurgitation. The process of assimilation and elimination of lithium and the cause of adverse reactions to lithium ingestation in bears probably are similar physiologically to human reactions to lithium treatments as reported by Gattozzi (1970) since reactions of humans to overdoses were similar to bear reactions to treatments.

Recovery

Within 24 hours after intitial treatment all test bears showed no symptoms of lithium sickness. Usually symptoms began to subside quickly after vomiting occurred. Gattozzi (1970) reported that within 24 hours adult humans eliminated one-half of ingested lithium from the body with the kidneys serving as the major eliminator.

No permanent changes in health conditions of any of the animals treated were apparent. Gattozzi (1970) stated that in humans the transient lithium-peak side effects are considered to be harmless upsets rather than warning signs of impending toxicity. Also, lithium treatments in modest concentrations exerted no discernible adverse influences to mother or offspring during pregnancy or nursing.

Table 2. Conditioning seven test bears to lithium chloride treatments.

Bear	*Days from Treatment to Last Recorded Aversion of Untreated Honey*	*Days from Treatment to First Recorded Acceptance of Untreated Honey*
Hubert	116	220
Blackjack	0	0
Oakey	213	Continuing
June	15	111
Mitch	112	Continuing
Black Ben	93	Continuing
Rosemary	15	30

Conditioning

Six of the seven bears treated with the dosage of lithium chloride were averted from eating pure honey for varying periods of time (Table 2). Blackjack accepted pure honey the first time it was offered to him and continued to accept it throughout the duration of the experiment. However, "spiked honey" which was reoffered to him several times was always refused without even a simple lick.

The maximum number of days from treatment to last recorded aversion of untreated honey was 213 days and the minimum zero days (Table 2). The maximum number of days from treatment to first recorded acceptance of untreated honey that can be reported was 220 days (Table 2); however Oakey, Mitch and Black Ben still had aversion to honey at the time of this report. Hubert and June were unable to be tested for a period of approximately three months and during that time period these bears lost their conditioning. Rosemary accepted honey after 30 days.

One explanation as to why Blackjack did not condition could be due to the fact that he ingested less than 20g of lithium chloride. This small dosage in relation to his size, over 700 pounds, probably explains his failure to condition. Of the other bears, the largest weighed about 350 lbs. The process by which animals establish taste aversion is discussed in detail by Garcia, Hankins and Rusiniak (1974) and will not be dealt with in this report.

No aversion for any other foods was exhibited by any of the test animals. Most of the bears readily accepted their staple diet after the lithium syndrome subsided. Hubert, Mitch, Oakey, Blackjack and June, which were located at the Okefenokee Swamp Park, were fed grapes, apples and dog feed mixed with cane syrup within 24 hours after treatment and each of the foods was consumed without reservation. This observation seems to agree with Gustavson, et al. (1974) who also found coyotes to specifically avert the foods which had made them sick while readily accepting other foods.

A strong possibility exists that eventually all of the test bears will lose aversion to honey. Coyotes that were conditioned against eating rabbits by feeding them tainted rabbits plus injections of lithium chloride eventually learned to kill and eat rabbit again. One of them reacquired the taste in one week, one in two weeks and one in four weeks (Gustavson and Garcia, 1974).

Each of the bears used in the test were already "hooked" on honey and probably would tend to lose aversion faster than an animal which became sick the first time it ingested a food. Gustavson et al. (1974) stated, "The feeding habits of the mother coyote averted to sheep might be transmitted to her pups via flavor which her diet imparts in her milk and by their early experience with the prey she brings to the den. Similar mechanisms have been demonstrated in the rat."

Initial results of lithium chloride treatments to bear indicate that it may have potential in aversion conditioning. However, additional studies should be conducted on dosage levels, length of conditioning and effects on both offspring and mother during pregnancy and lactation. Additional emetic chemicals such as lithium carbonate and lithium citrate should also be researched.

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