



Food Preferences and Rate of Mortality caused by Aspartame on *Camponotus*

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Abstract : *Camponotus* (Carpenter ants) are large ants with high sensory abilities. To access the preferred sweetener, the *Camponotus* were provided different sweeteners which included natural sweeteners such as jaggery, brown sugar, table sugar, glucose, fructose, sucrose and artificial sweeteners such as aspartame, sucralose and stevia. Preferred sweeteners were examined by the quantity they consumed most. Results indicated that ants first prefer natural sugar with high caloric value and greater sweetness. Their preference level was highest for jaggery followed by brown sugar and then table sugar. They were further more attracted

to fructose and sucrose and were least attracted to glucose, sucralose, aspartame and stevia. The effect of aspartame and sugar on the mortality rate of ants, if any, was also studied. It was found that aspartame based sweeteners do not cause serious mortality in ants. The overall mortality rate due to aspartame as compared to that of sugar was only 3.23%. It helps to understand that at low concentration aspartame is not lethal for the survival of *Camponotus*.

Keywords : Carpenter ants, Sweeteners, Food preferences, Aspartame, Mortality rate.

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Introduction:

Camponotus (Carpenter ants) are the eusocial insects of the Order Hymenoptera, Family Formicidae of Class Insecta. They are easily identified by their elbowed antennae and distinctive node like structure that forms their slender waists. They are large measuring about 0.76-2.54cm. These ants are indigenous to many forests of the world. They build nests inside the woods consisting of galleries, but they do not consume wood. Carpenter ants were used for this experiment because they have high sensory abilities than other insects.

Cammaerts (2016) stated that ants are used as models for studying effects of substances used by humans and they have a rapid development, being small can be collected in smaller samples.

Ants are known for easy detection of artificial and natural sweetening agents. The typical food of carpenter ants includes proteins and carbohydrates. Rani and Sanju (2016) reported that little is known about specific food preference of carpenter ants, except that they consist primarily of sweet food such as honeydew and dead insects.

Sweeteners are the substances used to improve the palatability and shelf life of the food. Sugars occurring naturally in many plant foods and are extracted mainly from raw honey, sugarcane, dates, jaggery, beetroot etc and are condensed. These are called natural sweeteners. A non-caloric substitute for sugar that is often intensely more sweet, such as aspartame, saccharin, sucralose, alitame etc are known as artificial sweeteners. Artificial sweeteners are available in the market as 'Sugar Free Gold' containing the mixture of aspartame and lactose, 'Sugar Free Natura' containing the mixture of dextrose and sucralose and 'Stevia' containing stevioside and rebaudioside. Tandel (2011) stated that artificial sweeteners attract consumers who want to control their weight or are insulin deficient. These substances mimic the taste of sugar while providing less energy.

The aim of the research was to determine the selective preference of ants species *Camponotus* for common household sweetener (glucose, fructose, sucrose, stevia, sucralose and aspartame) and for table sugar, brown sugar and jaggery. At the same time the present study is aimed to determine whether aspartame acts as an ant poison.

Materials and Methods :

Camponotus were used for basic research work as they were easily available in the college campus and were easy to trap. Ants were collected from natural habitat in groups.

The materials used were natural sweeteners such as glucose, fructose, sucrose, table sugar, brown sugar and jaggery and artificial sweeteners such as aspartame, sucralose and stevia.

For the first part of the experiment, which included 3 sets of observations, *Camponotus* ants were caught in group of 100 ants each, starved for a period of 6 hours, then each group of hundred ants were placed into a rectangular tupperware container along with 6 petri dishes containing 10 gram each of glucose, sucrose, fructose, stevia, aspartame and sucralose respectively.

The petri dishes were kept equidistant from each other along the edge of the container. Humidity in the container was maintained adding some water inside the container. For oxygen to be supplied to ants, the upper open part of the container was wrapped with muslin cloth, instead of closing the container, as muslin cloth contains very minute pores through which oxygen / air was available for ants. The experimental set-up was kept running for 2 days (48 hours) under normal environmental conditions. Photographs and records were taken of the number of ants found over each petri dish.

For the second set of experiment, 3 sets of observations were performed, where *Camponotus* ants were once again caught in groups of 100 specimens and were starved for a period of 6 hours. Afterwards they were placed into a rectangular tupperware container along with 3 petri dishes containing 10 gram each of table sugar, brown sugar and jaggery respectively. Humidity in the container was maintained by adding water. For oxygen to be supplied, again the upper open part of the container was wrapped with muslin cloth. The experiment was kept running for 2 days (48 hours) in normal environment. Photographs and records were taken of the number of ants found over each petri dish. The amount of sweeteners consumed by the ants was calculated using an electric weighing balance.

In the third set of experiment, *Camponotus* ants were caught in groups of 30 ants and were starved for a period of 6 hours. Ants were kept in plastic containers. 3 experimental groups were set up which received gelatinous medium made up of 10 grams of aspartame and 10 grams of wheat flour mixed with water. The control group received similar medium consisting of 10 grams of table sugar and 10 grams of wheat flour mixed with water. The experiment was kept running for one week at the normal room temperature. The surface of the plastic boxes was pierced so that oxygen was available for the ants.

Mortality rate of the ants was calculated at the end of the experiment and observations were made whether aspartame acts as poisoning agent. Mortality of ants in control groups was compared to that of experimental groups.

Results and Discussion :

The results of first set of experiment showed a strong attraction of the *Camponotus* ants to the fructose and sucrose samples while they displayed little interest

in the glucose, stevia, aspartame and sucralose samples (Table - 1).

Fructose and sucrose were eaten by ants completely while the other four samples which included glucose, stevia, aspartame, and sucralose were left in the petri dishes i.e. was not eaten by the ants. Percentage of Fructose consumed by ants was 100% followed by Sucrose with 90%, Glucose 2.33% and Aspartame 1%. Stevia and Sucralose were not eaten by ants at all.

Fructose absorbs moisture very easily and was liked by ants most as compared to sucrose and glucose.

It was observed that initially, Carpenter ants were attracted to Aspartame but soon, the whole group left. This is due to their pheromone factor as all ants follow their leader ants. Tinti and Nofre (2001) also reported that ants are not attracted by aspartame.

Table 1. Preference of various sweeteners by *Camponotus*.

Sl. No.	Sample	Initial Quantity (in grams)	Left Quantity (in grams)	Amount Consumed	Percentage Consumed
1.	GLUCOSE	10.00	9.76	0.23	2.33%
2.	FRUCTOSE	10.00	0.00	10.00	100.00%
3.	SUCROSE	10.00	1.00	9.00	90.00%
4.	STEVIA	10.00	10.00	0.00	0.00%
5.	SUCRALOSE	10.00	10.00	0.00	0.00%
6.	ASPARTAME	10.00	9.90	0.10	1.00%

Likewise, the specimens in the second sets of experiment showed a strong preference of *Camponotus* to the jaggery sample, followed by brown sugar and then table sugar.

Percentage of Jaggery consumed was 99.70% followed by Brown sugar 85.00% and then Table sugar 63.50%. This confirms that ants prefer natural products first and shows little interest in the refined ones (Table-2).

Table 2. Preference of Table sugar, Brown sugar and Jaggery by *Camponotus*

Sl. No.	Sample	Initial Quantity (in grams)	Left Quantity (in grams)	Amount Consumed	Percentage Consumed
1.	TABLE SUGAR	10.00	3.64	6.35	63.50
2.	BROWN SUGAR	10.00	1.49	8.50	85.00
3.	JAGGERY	10.00	0.03	9.97	99.70

The concluding part of the present study was to determine how aspartame affected survival rates of the ants. Mortality rate in the control group was 43.33% while in the experimental group was 46.56% (Table - 3). Kavya and Sailesh (2017) stated that more ants with access to aspartame died as compared to those that had access only to sugar.

Sorvari and Haatanen (2012) found in their experiment that the overall mortality was very low (<1.5%) and no difference in mortality rate were found within 24 and 96 hours.

Table 3. Rate of mortality in *Camponotus* caused by Sugar and Aspartame respectively.

Sl. No.	Sweetener	Total No. of Ants kept	Total No. of Ants Alive	Total No. of Ants Died	Mortality Rate in Percentage
1.	SUGAR	30	17	13	43.33
2.	ASPARTAME	30	16	14	46.56

In the present experiment, the mortality of carpenter ants observed in sugar and aspartame medium is in the ratio 13:14. Thus, overall mortality rate observed in ants due to aspartame is very low. It only exceeds by 3.23% from mortality rate in sugar. Thus, it is concluded that aspartame causes very less mortality of ants.

Rust et.al, (2000) stated that effective proportions of fats, carbohydrates and proteins in the bait may differ between species and with the colonies nutritional needs. Hooper-bui and Rust (2000) said that physical state of the bait, liquid versus solid and particle size also affect the rate of collection of ants on the bait.

The study indicated a varied attraction of ants among natural sugars and artificial sugars. Like humans, ants require a mixture of proteins, carbohydrates and fats in their diets. Because sugar contains high amount of carbohydrate, a number of ant species are attracted to food items that contain sugar. Ants use carbohydrates as an energy source. Artificial sweeteners, however, do not contain these carbohydrates and as a result, do little to attract ants.

Conclusion :

From the present studies it was concluded that *Camponotus* prefer food with higher degree of sweetness and greater caloric value. Their food preferences also depend on odour of the food. They

prefer jaggery most, followed by brown sugar and table sugar, as jaggery and brown sugar have characteristic smell.

They prefer semi liquid food as compared to solid foods as the latter is difficult for them to swallow. Fructose absorbs moisture very easily and thus is liked by the ants most as compared to sucrose and glucose. *Camponotus* show little interest in glucose because of its lower degree of sweetness. Ants are neither attracted to nor consume artificial sweeteners even if it is 200 times sweeter than sugar, as it doesn't fulfill the energy that is required for maintenance of their large chitinous body and their survival, further they do not contain carbohydrates.

From the observations, it can be concluded that aspartame based sweeteners do not cause serious mortality in ants. The overall mortality rate due to aspartame as compared to that of sugar was very less. So using ants it helps to understand that aspartame is not lethal for the survival of *Camponotus* at the concentration taken in the experiment.

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