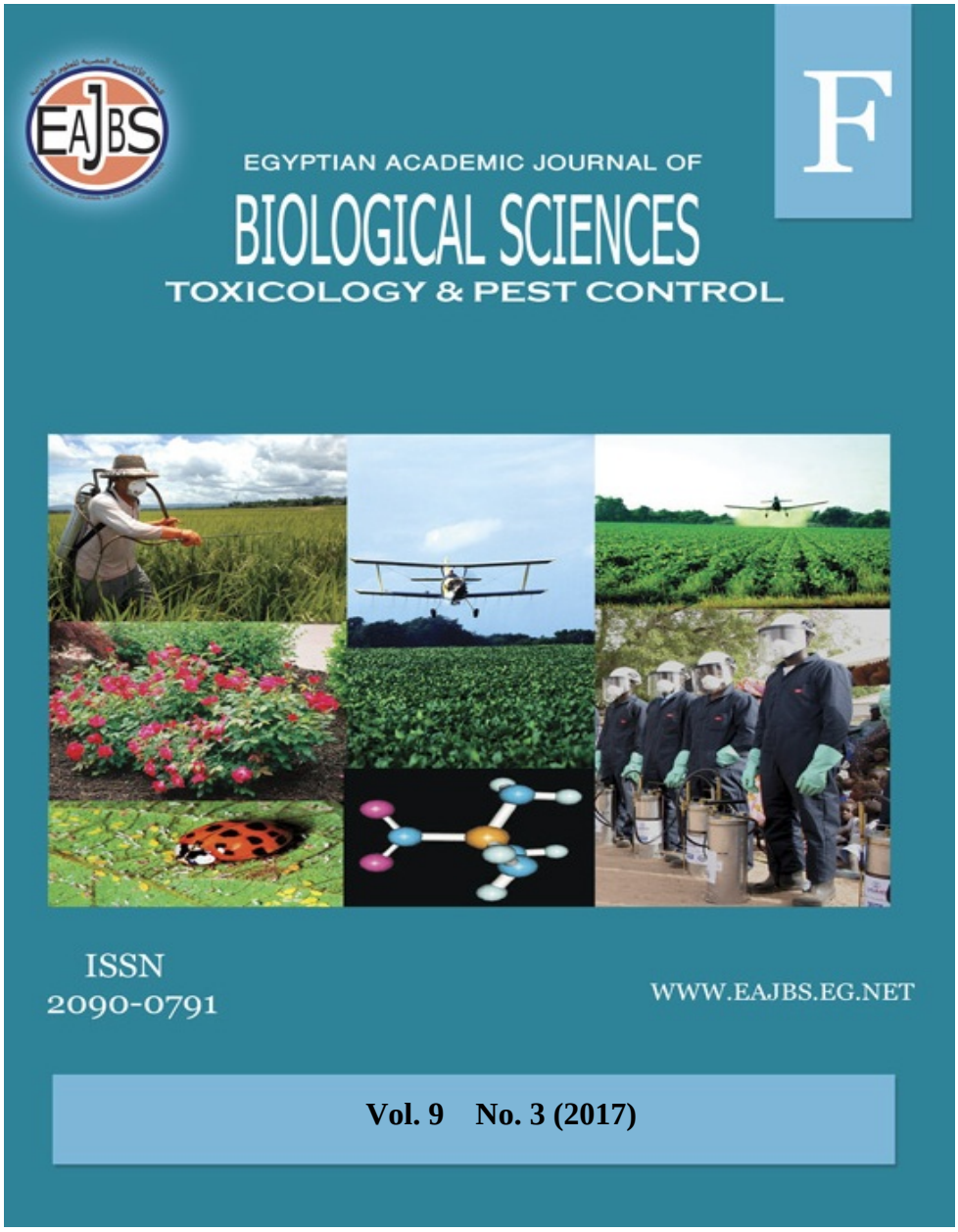

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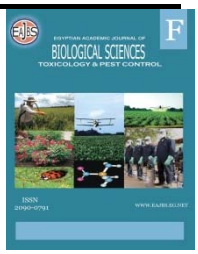

Nutritional Preference of Egyptian Fruit Bat, *Rousettus aegyptiacus* (Geoffroy) in Relation to its Control under Laboratory and Field Conditions

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ABSTRACT

Food preference and daily consumption of materials by the Egyptian fruit bat *Rousettus aegyptiacus* (Geoffroy) were investigated under laboratory conditions using free and non-choice feeding methods**.** The obtained results revealed that the acceptance of these materials to fruit bat relatively differed according to the type of materials and applied feeding method**.** Using none choice feeding method among the fruit, white mulberry was the highest accepted one to bats, while, black berry was the lowest. On the other hand, strawberry fruits ranked the first order between vegetable materials, while broad bean was the lowest one in fruit bat preference. At the same time, a tomato fruit was highly accepted by fruit bats as introduced food**.** The ratio of consumed diet and body weight considerably differed according to type of diet and reached the maximum in case of strawberry fruits to the ratio 90.6 % from bat body weight using free choice method**.** Under laboratory conditions, when zinc phosphid used in different concentrations mixed with pressed dates (Agwa) as bait, the obtained results indicated that the 1.5 % concentration achieved complete mortality (100 %) for the fruit bat community. Under the field conditions, of the Pyramids region, Giza Governorate, Zinc phosphide caused 78.2 % population reduction of the bat *R. aegyptiacus***.**

INTRODUCTION

Bats are the second most abundant group of animals after rodents in the world. In some tropical areas, there are more than species of bats than all other sexy of mammals together, Korine *et al*., (1999). The Egyptian fruit bat, *Rousettus aegyptiacus* (Order: Chiroptera, Family: Pteropodidae) is considered an agricultural pest, Kock (2001).Tomas *et al.,* (1984) observed that in most, the fruit bat caused a great damage on vegetables and fruits. The definition of the different bats as pests according to (Korine *et al*., 1999) based on a thorough investigation of the bat's natural diet, as well as on the extent of the actual damage to fruit crops, Mickleburgh *et al*., (1992). Such detailed information does not exist, and all the assessments of damage or food choice in the field are based on casual observations study conducted by Galil *et al.,* (1976). The bat *Rosettus aegyptiacus* is regarded as a pest for agriculture. In Israel and feed mainly on fruit sometimes leaves and pollen are also eaten, Persimmons, Loquats figs and dates fruit constitute 15 % of the bats diet, Korine *et al*., (1996). Feeding preferences of fruit bats are greatly influenced by the nutritional quality of fruit, Bonnaccorso and Gush (1987) and its hardness (Dumont 1999, Dumont and O'Neal 2004).

Although fruits are generally considered soft foods, they exhibit a wide range of textures, Strait and Overdorff (1996). Other researchers reported that bats feed wide kinds of plant (54 plant species according to plant availability and quality, season also, need of energy and protein, Feldhamer *et al*., (1995); Kunz and Diaz, 1995; Bizerril and Raw, 1998). Many researchers and farmers are painstaking to protect the farms of vegetables and fruits against attacks of fruit bats. In the nest bats, controlling is made by burning sulphur (30 g) with peprik (1g) per m^3. Another method used silky net for 7 days, Eisa, (2007). Sometimes poisoned bait was used as date with 96.3 % zinc phosphide bait. This work aims to determine the preference diet from tested vegetable, fruit or field crops to be used as bait with best effectiveness of zinc phosphide against fruit bait *R. aegyptiacus*.

MATERIALS AND METHODS

Bats:

The fruit bat, *R. aegyptiacus* individuals were collected by using insect trap from agricultural society in Aiatt district, Giza Governorate. Animals were transferred directly in cage 2.4 x 2.4 x 3.6 m to the laboratory. All bats had access to water and guava fruits. In laboratory, bats were housed in a communal wire mesh holding cages (90 x 50 x 50 cm). More than one bat/cage for three weeks before testing. They were allowed free access to the same diet and water for acclimatization, Manson *et al.,* (1989).

Palatability and food consumption of *R. aegyptiacus* to different fruits and vegetables using non-choice method.

In this study, some fruits (mixed date, Phoenix dactylifera, sycamore Fic*us sycamorus*, white mulberry *Morus alba*, grape *Vitis vinifera*, black mulberry *Morus nigra*, fig *Ficus rubiginose*, apricot *Prunus armenisa*, and peach *Prunus pasica* and vegetables, *strawberry Fargaria vesca,* tomato *Solanum lycopersicum*, cantaloupe *Cucumic canyalupe*, zucchini *Cucurbita popo*, peas *Psium sativum*, and kidney bean *Phaseolus vulgaris* were used as food for bats groups of five individual cages bats were used to each fruit and vegetable types. Two hundreds grams from each food material introduced to each bat four days interval and supplied by water. Every day, the remaining of food materials weighted. Then the average consumed food relative consumption were determined. Palatability and food consumption of *R. aegyptiacus* different fruit and vegetables using free choice method.

According to food introduced, bats were divided into four groups, two groups of fruits and vegetables as fallowing. The first group was including (mixed date), white mulberry, apricot and grapes. The second group, mixed date, black mulberry, sycamore and fig. The third group included strawberry, tomato, zucchini and kidney bean. The fourth group included strawberry, cantaloupe and peas. 200 gm from every food materials were presented to five individually caged bats in an individually way, and the consumed amount of food materials were daily recoded and replaced by fresh ones for successive days. The position of the food types was changed daily to avoid location preference, Buckel and Smith (1994).

$$\% \text{ Preference} = \frac{\text{Av. consumed of tested food}}{\text{Av. Total consumed (g)}} \times 100$$

Toxicity test:

Zinc phosphide (94 %) was obtained from Kafr El-Zayat (KZ) Pesticide Company, Egypt. Four groups (each 10 bats) were used per each concentration of poisoned compressed baits (0.2, 0.5, 1.0 and 1.5 zinc phosphide). Five balls of baits (each ball

20 g) were put in cage ceiling by rope .After one day the poisoned baits were removed and replaced by fresh diet and water. The consumed was calculated and dead animals were recorded during three days of treatment. An there experiment was used the repapered fruit dates and fig as bait 0.2, 0.5, and 1.0 % zinc phosphide. Groups of 30 baits each were used. Each group was divided into three sub-groups of 2 baits per each concentration. The bait consumption and dead baits were recorded during three days of treatment.

Field performance:

Field evaluation of dates mixed with 1 % zinc phosphide under the field conditions of the Pyramids region, Giza Governorate. An infested area with fruit bat *Rousettus aegyptiacus* was chosen and divided into 5 groups (park rooms) each of one, two parl rooms were chosen for each compound and one room left without treatment as check control. The population densities of the fruit bat *R. aegyptiacus* was estimated pre-and post-treatment using food consumption method according to Dubock (1984).Two kilograms of the candidate bait were packed into plastic sacks each contained 200 g and distributed in the chosen room for one week. The consumed amount of each tested bait was recorded. The percentage of population reduction was calculated as follows:

$$\text{Population reduction \%} = \frac{\text{Pre-treatment census} - \text{post-treatment censua}}{\text{Pre-treatment census}} \times 100$$

RESULTS AND DISCUSSION

The acceptance of different food items belongs to fruit group (dates, sycamore (sycamore fruit), white mulberry, grapes, black mulberry, fig, apricot and peach were tested for the Egyptian fruit bat. Data in Table (1) showed that under non-choice feeding method, the average consumption was 85.1, 80.3, 77.1, 77, 74, 73, 70.2, 68.5, and 60 g of mixed dates, mulberry fig, grapes, black mulberry, fig, apricot and peach, respectively.

Table 1: Palatability of fruit bat *Rousettus aegyptiacus* to different fruits using non-choice feeding method

Fruit type	Mean of body weight (g)	Average daily consumption (g)	Relative consumption
pressed dates (Agwa)	100	85.1±3.2	1
sycamore Fic*us*	98	80.3±2.5	0.84
White mulberry	105	77.1±2.2	0.90
Grapes	104	77.0±2.5	0.90
Black mulberry	95	74.0±3.1	0.86
Fig	93	73.0±2.8	0.85
Apricot	88	68.5±2.1	0.80
Peach	90	60.0±2.9	0.70
L.S.D. at 0.05		2.0862	0.1140

The relative consumption was highest one on dates (1%). Table (2) exhibits the average consumed amount of vegetables, as, they recorded 90.3, 87, 60.0, 45, 34, 23, and 17.2 g of strawberry, tomato, cantaloupe, zucchini, peas, and kidney bean, respectively. The relative consumption after strawberry ranked as follows: tomato 0.9 %, cantaloupe 0.66 %, zucchini 99%, peas 25 %, and kidney bean 0.18 % during non-choice feeding method.

Table 2: Palatability of *Rousettus aegyptiacus* to vegetables using non-choice feeding method

Vegetable type	Mean of body weight (g)	Average daily consumption (g)	Relative consumption
Strawberry	105	90.3±3.5	1
Tomato	100	87±3.2	0.96
Cantaloupe	103	60±2.9	0.66
Zucchini	102	45±2.7	0.99
Peas	98	23±1.5	0.25
Kidney bean	104	17.2±1.6	0.18
L.S.D. at 0.05		1.4167	0.0914

Free-choice feeding method:

Under free choice method, the same food materials were tested measure their acceptance for the Egyptian fruit bat. The food materials were divided into two groups,i.e. fruits types (mixed date, white mulberry, apricot and grapes) and (dates, black mulberry, mulberry, Table 3).

The obtained data showed that the weight of food consumed (gram) by one animal (weight 160 g) was 80, 77, 70 and 34 g with relative to dates 1, 0.96, 0.87, and 0.42 after the 4th day of feeding on mixed dates, white mulberry, apricot, and grapes (as first group), respectively.

Table 3: Food preference of fruit bat *Rousettus aegyptiacus* to free choice feeding method

Food material	Average daily consumed (g)	Acceptance rate
Mean of body weight (g) 160		
pressed dates (Agwa)	80.0	1.0
White mulberry	77.0	0.96
Apricot	70.0	0.87
Grapes	34.0	0.42
L.S.D. at 0.05		0.0981
Mean of body weight (g) 170		
pressed dates (Agwa)	78.0	1
Black berry	55.0	0.78
sycamore Fic*u*s	59.0	0.70
Fig	58.0	0.74
L.S.D. at 0.05		0.010

In case of dates, black mulberry, mulberry fig and fig (the second group) the food consumption reached 78, 55, 59 and 58 g with ratios of 1, 0.70, 0.75, and 0.74, respectively, when the bat weight 170 g**.** Regarding the profile of vegetable preference to the bat, date in Table (4) indicated that the fruit bat, 180 g as mean of body weight the daily consumed food were 90.6, 82.2, 33.2, and 12.2 g from strawberry, tomato, zucchini, and kidney been, respectively, and the relative acceptance of introduced food were 1.0, 0.90, 0.36, and 0.13, respectively. Furthermore, to evaluate the acceptance rate of tomato, zucchini, and kidney bean comparing with strawberry under free choice method, all food types were introduced to bat. Results in Table (4) indicated that bat with 170 g as mean of body weight; the daily consumed food was 90, 44, and 11.3 g from strawberry, cantaloupe, and peas, respectively. And the relative acceptance of introduced food were 1, 0.47, 0.17 and 0.12, respectively as mentioned strawberry. Bats preferred fruits and consumed large amount of them compared with vegetables, Tomas *et al*., (1984) found that male bat consumed a large amount of food compared with female bat. Both sexes preferred fruits more than vegetables under none and free-choice methods.

Table 4: Food preference of fruit bat *Rousettus aegyptiacus* to vegetables using non-choice feeding method

Food material	Average daily consumed (g)	Acceptance rate
Mean of body weight (g) 180		
Strawberry	90.6	1
tomato	88.2	0.90
Zucchini	33.2	0.36
Kidney bean	12.2	0.13
L.S.D. at 0.05		0.1054
Mean of body weight (g) 170		
Strawberry	90.0	1
Cantaloupe	44.0	0.47
Peas	11.3.0	0.12
L.S.D. at 0.05		0.0879

Toxicity of zinc phosphid baits against fruit baits:

The four tested compressed date poisoned baits of zinc phosphid (0.2, 0.5 1 and 1.5 %) caused different mortality percentages in bat. Results in Table (5) showed that the concentration of 0.2 % killed 20 % of tested animals; the mean consumed bait was 10.4 g while 60 % from treated animal diet after consumption 9.8 g of poisoned bait of 0.5 % other concentration: 1 and 1.5 % caused the same mortality percentage (90 and 100 %) the concentration, bait was 7.3 and 7.0 g to each concentration, respectively.

Table 5: Toxicity of different concentration of zinc phosphide compressed date against *Rousettus aegyptiacus* under laboratory conditions

Mean of body weight	Zinc phosphide concentration %	Consumed bait (g)	Mortality %
115	0.2	10.4	20
110	0.5	9.8	60
100	1.0	7.3	90
103	1.5	7.0	100

In evasion to enhancing the mortality percentage with low concentration of zinc phosphide by increasing the lethal dose of zinc phosphide by increasing the lethal dose intake of preferred fruit (dates and fig) were used as bait compared with compressed data in Table (6). Revealed that dates baits 0.2, 0.5 and 1 % zinc phosphide were, 19.9 and 17 g, respectively cause 60, 100 and 100 % mortality and the bait consumption were 13.5, 12.1 and 12 g, while fig bait of the same consumption cause 40 and 60 and 99 % mortality of treated animals and the bait intake.

Table 6: Effect of dates and fig baits poisoned with zinc phosphide against bat *Rousettus aegyptiacus* under laboratory conditions

Food	0.2 %		0.5 %		1 %	
	Consume bait (g)	Mortality %	Consumed bait (g)	Mortality %	Consumed bait (g)	Mortality %
Dates	13.5	40	19.9	70	17	90
Fig	19.6	60	12.1	100	12	100

The mortality percentages of fruit bait were the highest and dates poisoned baits compared with fig and compressed date. The dates poisoned bait caused highly percentage of bats mortality more than fig bait in spite of reducing the dates

bait intake. This observation may be due to fig water content which attributed to loss of phosphine gas from zinc phosphide and reduced the toxic effect. By using the biological method, Rizk (2002) found that poisoned bait of zinc phosphide 2.5 % lost 20 % and 50 % of its effectiveness when exposed to 80 % RH for 2 and 7 days. The efficiency of 1 % zinc phosphide was tested against the fruit bat *R. aegyptiacus* under field conditions of Pyramid region, Giza Governorate. Results in Table (7) show that zinc phosphid with date Agwa caused 78.2 % population of the fruit bat population. The average of bait consumption was 48 per feddans for zinc phosphid. El-Deeb *et al*., (1991) found that 1.5 % of zinc phosphide bait gave 64 and 70 % population reduction of *Arvicanthis niloticus* and *Meriones showi*. Rizk and Eissa (2013) concluded that the concentration of 1.0 % of zinc phosphide with apple caused 100 % mortality against fruit bat, *R. aegyptiacus*, compared with the same concentration of guava and compressed date where the mortality was 70 and 60 % and the average bait consumption was 15.3, 20.4 and 10.9 g, respectively.

Table 7: Field performance of date Agwa with 1% zinc phosphid against the fruit bat *Rosettus aegyptiacus* at Giza Governorate

Compound	Average consumption (g) m^2			% Population reduction
	Pre-treatment	Poisonous bait	Post-treatment	
Date Aga with Zinc phosphid	660	648	100	78.2
Control	660	-	-	-

REFERENCES

Bizerril, M.X.A. and Raw, A. (1998). Feeding specialization of two species of bait bat and the fruit quality of pepper arboretum in a central Brazilian gallery forest. Revista de Biologogia tropical, 45(2):913-978.

Bonaccorso F. J. and Gush, T. J. (1987). Feeding behavior and foraging strategies of captive phyllostomid fruit bats; an experimental study. J. Anim. Ecol., 56:907– 920

Buckel, A.P. and Smith, R. H. (1994). Rodent pests and their control. Cab. International UK: 161-181.

Dubock. A. C. (1984). Pulsed baiting- a new technique for high potency, slow acting rodenticides. Proc. Cont. of the Organization and Prad. of Vertebrate Pest Control, U.K., 105-143

Dumont, E. R. (1999). The effect of food hardness on feeding behaviour in fungivorous bats Phyllostomidae): an experimental study. J Zool (Lond.) 248: 219−229

Dumont E.R. and O'Neal, R. (2004). Food hardness and feeding behaviour in Old World fruit bats (Pteropodidae). J Mammal 85: 8−14.

Eisa, Y.A. (2007). Ecological, biological and toxicological studies on fruit bat. Ph.D. Thesis, Fac. Agric. Al-Azhar Univ.,

El-Deeb, H.I.; Abdullah, M.D.A.; Kandil, M. A. and Gabr, W.H. (1991). Laboratory and field studies with zinc phosphide on different rodent species. 4th Arab Cong., Plant Prot., Cairo, 1-5 December: 494-499.

Feldhamer, G.A.; Whitakere, O.; Kercica, J. K. and Taylor, S. I. (1995). Food the evening bat (*Nycticeius humerlais* and red bat *Lasiurys borcalis* from Southern Illinois. Thrans. Imionoisis Stat. Acad. Sci., 88(3-4):139-143.

Galil, J.; Stein, M. and Horoviz, A. (1976). On the origin of the Sycamore fig (*Ficus sycamores* L.) in the Middle East. Gardens' Bulletin XXIX, 191-205.

Kock, D. (2001). *Rosettus aegyptiacus* (E Geoffrey St. Hilare, 1810) and *Pipistrellus anchielae anchietae* (Seabra, 1900) justified emendations of original spekilings. Acta Chiropterologica, 3 92): 145-148.

Korine, C. I., Arad, Z. and Arieli, A. (1996). Nitrogen and energy balance of the fruit-bat, *Rousettus aegyptiacus*, on

natural fruit diets. Physio-logical Zoology 69, 618-634.

Korine, C. I.; Izhaki, I. and Zeev, A. (1999). Is the Egyptian fruit-bat *Rousettus aegyptiacus* a pest in Israel? An analysis of the bat's diet and implications for its conservation. Biological Conservation 88, 301-306.

Kunz, T. H. and Diaz, C.A. (1995). folivory in fruit–eating bats with new evidence from *Artibeus jamaicensis* (Chiroptera: Phyllostomidae). Biotropica, 27 (1): 106-120.

Manson, J.R.; Avery, L. and Otis, D.L. (1989). Standard protocol for evaluation of repellent effectiveness with birds. Bird section Res., Rep. No. 208 Pp; 1-20.

Mickleburgh, S.P., Hutson, A.M., Racey, P.A., (1992). Old world fruit bats. An action plan for their conservation. IUCN, Switzerland.

Rizk, A. (2002). Comparative studies on zinc phosphid (Rodenticide). M.Sc. Thesis, Fac. Agric., Al-Azhar Univ., 97 pp.

Rizk, A. M. and Eissa Y.A. (2013). Preference of some food types and their efficacy as poisoned baits (zinc phosphide) against fruit bat under laboratory conditions. Egypt. Acad. K. Sci., 5 (2): 17-23.

Schafer, J. and Brunton, R.B. (1971). Chemical bird repellents: Two promising agents. J. World. Manag, 35:569-572.

Shumak, S. A.; Gaddris, S.E. and Schafer, E.W (1979). Behavioral response of queleu to methiocarb in proceedings of the 7th bird Control Seminar, Bowling Green, Ohio, 7:250-254.

Starr, R. I.; Besser, J.E. and Brunto, R.B. (1964). A Laboratory method for evaluating as bird repellent. J. Agric. Food Chem., 12: 243-244.

Strait S.G. and Overdorff, D.J. (1996).Physical properties of fruits eaten by Malagasy primates. Am. J. Phys Anthropol Suppl 22: 224

Tomas, F. M.; Murray, A. S. and Ones, L. M. (1984). Modification of gluccorticoinduced exchanges in myolibrill as protein turnover in_rates by protein and energy difiency as assessed by urinary excretion of N-melhythis-tidine Br. J. Nut., 51: 323-337.

ARABIC SUMMERY

التفضيل الغذائى للخفاش المصرى اكل الفاكهة *Rousettus aegyptiacus* وعلاقته بالمكافحة تحت الظروف الحقلية والمعملية

يونس احمد السيد عيسى

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – جيزة – مصر

تم دراسة التفضيل الغذائى للخفاش المصرى اكل الفاكهة باستخدام طريقتى التغذية الاختيارية والتغذية اللا اختيارية وذلك تحت الظروف المعملية. وقد اشارت النتائج المتحصل عليها ان استساغة الخفاش للمواد المقدمة له اختلفت نسبيا باختلاف نوع المادة الغذائية وايضا حسب طريقة التغذية المستخدمة. وعند استخدام طريقة التغذية الغير اختيارية وجد ان ثمار التوت الابيض كانت اكثر الانواع الغذائية استساغة للخفاش بينما كانت ثمار التوت الاسود اقلها استساغة. من ناحية اخرى وجد ان ثمار الفراولة كانت افضل انواع الخضار المقدمة بينما جاءت ثمار الفول البلدى فى المرتبة الاخيرة للاستساغة.ولوحظ ايضا ان ثمار الطماطم كانت من افضل الاغذية استساغة للخفاش. ولقد وجد ان نسبة استهلاك الغذاء ووزن الجسم للخفاش قد تاثرت بصورة واضحة تبعا لنوع الغذاء المستخدم وايضا حسب طريقة التغذية حيث لوحظ ان ثمار الفراولة كانت افضل الثمار المقدمة حيث اعطت نسبة استهلاك مقدارها ٩٠.٦ % من وزن الخفاش وذلك عند استخدام طريقة التغذية الاختيارية.كما تشير النتائج المتحصل عليها انه عند استخدام تركيزات مختلفة من فوسفيد الزنك فى صورة طعم مع عجوة البلح وجد ان التركيز ١ % ادى الى نسبة موت ١٠٠ % من تعداد الحيوان. لذلك يوصى باستخدام البلح العجوة معاملا بفوسفيد الزنك كطعم لمكافحة الخفاش المصرى اكل الفاكهة.