

**EFFECT OF DIFFERENT TYPES OF FOOD ON  
DEVELOPMENTAL STAGES, FECUNDITY AND LIFE TABLE  
PARAMETERS OF THE ACARID MITE *RHIZOGLYPHUS  
ECHINOPUS* (FUMOUCHE & ROBIN, 1868)**

**H. A. Taha<sup>(1)</sup>, M. Fawzy<sup>(1)</sup>, A. E. El Ghobashy<sup>(2)</sup> and Zeinab E. Abdel Salam<sup>(1)</sup>**

<sup>(1)</sup> Plant Protection Research Institute, Agric. Res. Center, Dokki, Giza., Egypt

<sup>(2)</sup> Zoology Department, Faculty of Science, Damietta University, Damietta, Egypt.

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**ABSTRACT:** *Dry yeast granules, cheese and crushed wheat were tested as a nourishment of Rhizoglyphus echinopus (Fumouze & Robin, 1868) under laboratory conditions of 25±1°C and 70% R.H. Statistical analysis of the obtained results showed that developmental stages, fecundity and life table parameters of the acarid mite, R. echinopus were significantly different among the three types of food, whereas, the total immature stages were (13.08 & 11.9), (13.5 & 12.4) and (16.0 & 15.8 days) for female and male when fed on dry yeast, cheese and crushed wheat, respectively. Female oviposition period lasted (15.7, 20.3 and 23.00 days) and deposited average numbers of eggs & a daily rate (245.4 & 15.86), (190.8 & 9.4) and (101.5 & 4.4) eggs, respectively. Obtained data from the biochemical analysis of food composition showed that the dry yeast granules which have the highest protein content (30.63 %) seem to be an attractive and effective diet for rearing the acarid mite, R. echinopus in the laboratory.*

**Key words:** *Life table, acarid mite, Rhizoglyphus, food types, flour mite, cheese, flour*

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## **INTRODUCTION**

Mites are one of the major pests that infest a variety of stored products throughout the world. Mites distributional pattern is not constant everywhere, but varies according to the environmental factors, where it either free living (phytophagous, graminivorous, fungivorous and saprophagous), parasitic and predatory mites on other injurious mites or insects, Taha (1985), Mohamed (2003), Putatundia (2005), Habashy (2006) and Mostafa *et al.* (2006). Mites associated with stored products causing serious variable degree of damage not only they can consume large amounts of stored products, but also contaminate food with their bodies and extractions. During favorable conditions, the mite population in the stored products may markedly increase, making it unsuitable for humane and domestic animal's consumption, Taha (1985), Sallam *et al.* (2007).

The present work aims to study the effect of different types of food on biological

aspects, fecundity, longevity, life span and life table parameters *R. echinopus* under laboratory conditions.

## **MATERIALS AND METHODS**

A stock culture of *R. echinopus* collected from a flour sample, which collected from Damietta Governorate. Mites were collected in petri-dishes (6 cm. diameter x 1.5 cm. high). Two females and a male from the laboratory culture of *R. echinopus* were isolated in another Petri-dish for 24 hours to obtain the required number of eggs for biological studies. Newly deposited eggs were transferred solitary each to a plastic cell filled partially with a mixture of cement, clay and charcoal (1.3 cm. diameter x 0.4 cm high). Newly hatched larvae were fed during their life span on one of tested diets, dry yeast granules, cheese and crushed wheat under laboratory conditions at 25±1°C and 70 % R.H. Thirty replicates were used for each source of diet, investigated twice daily with adding few amounts of different food types and few drops of water as

required. Biological aspects as fecundity, longevity, life span and life table parameters were studied. Biochemical analysis of food composition, moisture content using the methods described in the AOAC (1990), quantitative determination of lipids according to the method of Schneider *et al.* (1950), colorimetric determination of total protein, Lowry *et al.* (1951), carbohydrate content by the method described by James (1995) and ashes was determined according to Pearson (1981). All statistical analyses were calculated, using the computer programs of SPSS (version 20.0 for Windows) and Excel (2010).

## **RESULTS AND DISCUSSION**

Under laboratory conditions, the three types of food, dry yeast granules, cheese and crushed wheat were found to be suitable for mite survival and development, but the dry yeast granules was the best food for the acarid mite, *R. echinopus*.

### **Habitat and behavior:**

The mite *R. echinopus* was found in large numbers inhabiting different stored products such as bran, cheese and flour in different localities (Kafrsaad, Faraskour and El Zarka) of Damietta Governorate. The mite passed through the larval and two nymphal stages (protonymph and tritonymph) before being adults and between each stage of them the individual enters in quiescent period, in which it made a dry hole or crack in the substrate of the rearing cells, ceases feeding and movement. The egg is oval in shape and translucent when newly deposited, before hatching, it changes to pale white and brown spots appear at anterior part of the egg from which the hatching takes place.

### **Mating:**

Mating process occurred immediately after emergence of adult female. Female needs copulation several times to put all of its eggs. During copulation the male assumed a dorsoposterior position with female. The female can move but in slow motion while the male on its back and then

the latter separate and move away from female. Mating lasted about 10 -15 minutes.

### **Hatching:**

Eggs were laid singly or in clusters and scattered under particles of substrate and sometimes inside food particles, and the eggs are spherical and translucent, then changes to white color and enlarged near the hatching. During hatching the shell rupture through a longitudinal slit from which larva crawls with its legs. This process lasted about 15-20 minutes. The hatching larva stayed inactive for a short period about 5-10 minutes, and then began its activity.

### **Moulting:**

The immature stages of *R. echinopus* entered the quiescent stage in which the body swelled and enlarged. The quiescent period they never respond to any stimulation. The old skin is rupture gradually from posterior part of the body to the anterior part. During moulting the individual is crawled in a round moving and then in the late of moulting the individual is stopped from moving and the moulting skin become rupture from posterior part. The newly emerged individual kept quite beside its old skin for a short period, then started to move activity searching for food. The moulting period is about 20 to 30 minutes.

### **Developmental stages:**

As shown in Tables (1&2) there were significant differences for the influence of different food types on egg incubation period of female and male, under laboratory conditions at  $25\pm 1^{\circ}\text{C}$  and 70 % R.H. Incubation period lasted 4.0, 4.6 & 7.1 days for female, while it lasted 3.5, 4.0 & 4.1 days for male when fed on dry yeast, cheese and crushed wheat, respectively. All the selected food was found suitable for mite survival and development. The total immature stages female and male of *R. echinopus* were affected by the types of food; where female duration were 13.08, 13.5 & 16.00 days, while lasted 11.9, 12.4 & 15.8 days for male

**Effect of different types of food on developmental stages, .....**

when it fed on dry yeast, cheese and crushed wheat, respectively. The male reached the mature stage before female.

Obtained data showed that dry yeast was the faster life cycles (17.08 & 15.4) than cheese (18.1&16.4) and the crushed wheat (23.1 & 19.9) was the longest one for female and male respectively. These results matched with Mathur and Dalal (1985), Taha *et al.* (2002) and Mahmoud *et al.*, (2013). Also Bielska (1983) and Chmielewski (2001) proved that the type of food affected the duration of the total development cycle. The female and male longevity affected by the food type. These results were coincided with that obtained by Bielska (1983) and Chmielewski (2001). A dry yeast granule was the most attractive food for *R.*

*echinopus* followed by cheese and the least was the crushed wheat. As shown in table (3) the fecundity also (245.4, 190.8 & 101.5 eggs) with daily rate (15.86, 9.4&4.43egg/days) when fed on dry yeast, cheese and crushed wheat, respectively. Thus, the dry yeast stills the best food for the female *R. echinopus*. Fecundity of *R. echinopus* studied also on buckwheat by Chmielewski (2001). *R. echinopus* life span durations were significantly affected by different diets which were 39.38, 45.1 &54.00 days for female, while it was 34.1, 40.3 & 47.4 days when fed on dry yeast, cheese and crushed wheat, respectively. These results were coincided by Bielska (1983) and Chmielewski (2001).

**Table (1): Duration of different stages of *Rhizoglyphus echinopus* female fed on different food types at 25C° and 65%±5% R.H.**

Stages		Types of food			P
		Dry yeast	Cheese	Crushed wheat	
Incubation Period		4.00±0.82 <sup>b</sup>	4.6±0.70 <sup>b</sup>	7.1±0.88 <sup>a</sup>	0
Larva	A	3.40±0.84 <sup>a</sup>	4.2±1.03 <sup>a</sup>	3.7±0.67 <sup>a</sup>	0.38
	Q	1.25±0.53 <sup>a</sup>	1.3±0.48 <sup>a</sup>	1.6±0.52 <sup>a</sup>	0.119
Protonymph	A	3.40±0.70 <sup>b</sup>	2.7±0.95 <sup>b</sup>	3.8±0.42 <sup>a</sup>	0
	Q	1.30±0.42 <sup>b</sup>	1.5±0.53 <sup>a&amp;b</sup>	1.6±0.52 <sup>a</sup>	0.008
Tritonymph	A	2.70±0.82 <sup>b</sup>	2.5±0.53 <sup>b</sup>	3.5±0.71 <sup>a</sup>	0
	Q	1.03±0.28 <sup>b</sup>	1.3±0.48 <sup>b</sup>	1.8±0.42 <sup>a</sup>	0
Total immature		13.08±1.07 <sup>b</sup>	13.5±1.51 <sup>b</sup>	16.0±1.51 <sup>a</sup>	0
Life cycle		17.08±1.19 <sup>b</sup>	18.1±1.45 <sup>b</sup>	23.1±1.29 <sup>a</sup>	0
Longevity		22.30±1.89 <sup>c</sup>	27.0±1.56 <sup>b</sup>	30.9±2.02 <sup>a</sup>	0
Life span		39.38±2.50 <sup>c</sup>	45.1±2.13 <sup>b</sup>	54.0±2.26 <sup>a</sup>	0

A = Active stage Q = Quiescent stage P = correlation is significant at P <0.05  
Means in each column followed by the same letter are not significantly different at 5% level.

**Table (2): Duration of different stages of *Rhizoglyphus echinopus* male fed on different food types at 25C° and 65%±5% R.H.**

Stages		Types of food			P
		Dry Yeast	Cheese	Crushed wheat	
Incubation Period		3.50±0.71 <sup>b</sup>	4.00±0.82 <sup>b</sup>	4.10±0.57 <sup>a</sup>	0
Larva	A	3.20±0.63 <sup>a</sup>	3.00±0.67 <sup>a</sup>	3.60±0.84 <sup>a</sup>	0.38
	Q	1.13±0.29 <sup>a</sup>	1.50±0.53 <sup>a</sup>	1.40±0.52 <sup>a</sup>	0.119
Protonymph	A	3.00±0.67 <sup>b</sup>	2.80±0.42 <sup>b</sup>	4.10±0.74 <sup>a</sup>	0
	Q	1.10±0.24 <sup>b</sup>	1.20±0.42 <sup>a&amp;b</sup>	1.70±0.48 <sup>a</sup>	0.008
Tritonymph	A	2.50±0.71 <sup>b</sup>	2.70±0.82 <sup>b</sup>	3.60±0.52 <sup>a</sup>	0
	Q	0.98±0.18 <sup>b</sup>	1.20±0.42 <sup>b</sup>	1.40±0.52 <sup>a</sup>	0
Total immature		11.9±1.44 <sup>b</sup>	12.4±1.51 <sup>b</sup>	15.8±1.14 <sup>a</sup>	0
Life cycle		15.4±1.04 <sup>b</sup>	16.4±1.65 <sup>b</sup>	19.9±1.29 <sup>a</sup>	0
Longevity		18.7±1.34 <sup>a</sup>	23.9±1.2 <sup>b</sup>	27.5±1.08 <sup>c</sup>	0
Life span		34.1±0.96 <sup>a</sup>	40.3±1.83 <sup>b</sup>	47.4±0.97 <sup>c</sup>	0

A = Active stage Q = Quiescent stage P = correlation is significant at P <0.05

Means in each column followed by the same letter are not significantly different at 5% level.

**Table (3): Adult female longevity and fecundity of *Rhizoglyphus echinopus* when fed on different food types at 25C° and 65%±5% R.H.**

Types of food	Average duration (days)			Longevity (days)	Fecundity	
	Preovi-position Period	Ovi-position Period	Postovi-position period		Total Egg	Daily rate
Dry yeast	3±0.94 <sup>b</sup>	15.7±2.06 <sup>c</sup>	3.6±0.84 <sup>a&amp;b</sup>	22.3±1.89 <sup>c</sup>	245.4±18.69 <sup>a</sup>	15.86±2.3 <sup>a</sup>
Cheese	3.3±0.82 <sup>a&amp;b</sup>	20.3±1.57 <sup>b</sup>	3±0.67 <sup>b</sup>	26.5±2.64 <sup>b</sup>	190.8±17.25 <sup>b</sup>	9.4±0.73 <sup>b</sup>
Crushed wheat	4±0.63 <sup>a</sup>	23.0±2.19 <sup>a</sup>	3.9±0.7 <sup>a</sup>	30.9±1.92 <sup>a</sup>	101.5±12.53 <sup>c</sup>	4.4±0.52 <sup>c</sup>
P	0.032	0	0.038	0	0	0

A = Active stage Q = Quiescent stage

P = correlation is significant at P <0.05

Means in each column followed by the same letter are not significantly different at 5% level.

**Effect of different types of food on developmental stages, .....**

Life table parameters, Table (4) were affected by the different food types. The dry yeast granules were the shortest mean generation time 24.56 days, while the longest occurred with crushed wheat 28.91 days. The net reproduction time ( $R_o$ ) was the highest value on crushed wheat (61.78) followed by dry yeast (14.63), and the lowest was cheese (11.59). Intrinsic rate of increase ( $r_m$ ) show the highest value for dry yeast (0.39) and the lowest values was for crushed wheat while, the moderate value was for cheese (0.38). Finite rate of increase ( $exp_{r_m}$ ) also affected by food type showed 1.48 for dry yeast (the highest), 1.46 for cheese (the moderate) and 1.35 for crushed wheat (the lowest). Finally sex ratios

(%female/total) were 0.69, 0.68 and 0.66 also affected by the food types for the same tested food types. These results agree with Mahmoud *et al.*, (2013).

Biochemical analysis of food composition, Table (5) showed that the percentage of the protein content affected the biological aspects of *R. echinopus*, where it was the highest in dry yeast granules (30.36) and lowest in crushed wheat (10.94) while moderate in cheese (24.06) thus; the dry yeast granules proved the most favorable food for the acarid mite *R. echinopus*. The remaining food composition has no clear effect on the biological studies of *R. echinopus*.

**Table (4): The effect of different food types on life table parameters of *Rhizoglyphus echinopus***

Parameters	Dry Yeast	Cheese	Crushed wheat
Net reproduction time ( $R_o$ )	14.63	11.59	61.78
Mean generation time (T)	24.56	24.74	28.91
Intrinsic rate of increase ( $r_m$ )	0.39	0.38	0.30
Finite rate of increase ( $exp_{r_m}$ )	1.48	1.46	1.35
Sex ratio (%female/total)	0.69	0.68	0.66

**Table (5): Average percentage of different biochemical components of food types.**

Food type	Moisture%	Protein%	Fats%	Carbohydrate%	Ash%
Yeast	5.5	30.63	9.47	51.43	2.97
Cheese	33.75	24.06	21	15.15	6.04
Crushed wheat	6.15	10.94	2.61	79.67	0.63

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تأثير أنواع مختلفة من الغذاء علي التطور والخصوبة وجداول الحياة للحلم الأكاريدي  
*Rhizoglyphus echinopus*

حسن علي طه<sup>(١)</sup> ، مجدي فوزي<sup>(١)</sup> ، أحمد السيد الغباشي<sup>(٢)</sup> ، زينب عصام عبد السلام<sup>(١)</sup>

<sup>(١)</sup> معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - الجيزة- مصر

<sup>(٢)</sup> قسم علم الحيوان - كلية العلوم - جامعة دمياط - مصر .

**الملخص العربي**

تحت الظروف المعملية ، و عند درجة حرارة ٢٥ م° و رطوبة نسبية ٧٠ % ، استخدمت ثلاثة أنواع من الغذاء (الخميرة الجافه و الجبنة و القمح المجروش) كتغذية للحلم الأكاريدي *Rhizoglyphus echinopus* أوضحت الدراسة أن أطوار النمو، الخصوبة، و جداول الحياة جميعهم تأثروا بإختلاف نوع الغذاء، حيث استغرقت الأطوار غير الكاملة (١٣,٠٨ / ١١,٩) ، (١٣,٥ / ١٢,٤) ، (١٦,٠٠ / ١٥,٨) يوماً للذكر والأنثي علي التوالي عند التربية علي الغذاء السابق ذكره. بالنسبة لفترة وضع البيض كانت ١٥,٧ و ٢٠,٣ و ٢٣,٠ يوماً و كان متوسط عدد البيض وعدد البيض اليومي ( ١٤٥,٤ / ١٥,٨٦) و (١٩٠,٨ / ٩,٤) و (١٠١,٥ / ٤,٤) علي التوالي. وبعد اجراء التحاليل الكيمائية لمحتوى انواع الغذاء الثلاثة أثبتت النتائج المتحصل عليها ان التغذية على الخميرة الجافة هي الأكثر نجاحا لتربية الحلم الأكاريدي *Rhizoglyphus echinopus* معمليا.

