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Effect of Natural Falling and Dipping of House Fly *(Musca domestica)* on the Microbial Contamination of Water and Milk

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ABSTRACT. The effect of natural falling and dipping of house flies on the degree of contamination of sterile water and milk was investigated. The study was made on sterile tap water and also on sterile water at pH 4, which represents the reaction of stomach fluids.

It was found that the total microbial flora showed progressing drop in their counts after 60 minutes incubation. Dipping treatments of house flies gave lower microbial contamination of water at pH 4 than at neutral pH. This trend was also observed for non-haemolytic and haemolytic microflora determined on blood agar medium. Dipping the house flies three times generally resulted in lower microbial count than natural falling and dipping once treatments.

It was also found that complete dipping of fly in milk reduced the initial microbial contamination and retarded their growth. This paradoxial result is quite interesting since the logical condition, if the microbial load is only a matter of contamination without the influence of any other factor, is that dipping treatment would give higher figures than natural falling. All these observations suggest the presence of antimicrobial factors on the house flies.

Introduction

It is well known fact that house fly *(Musca domestica)* is one of the most important and transmitors of many pathogenic microorganisms. Smith[1], Frobisher *et al.*[2] and Nester *et al.*[3] indicated that house fly is able to transmit virus diseases, such as poliomyelitis and coxsakie viruses, bacterial diseases such as enteric fever, bacillary

dysentery, typhoid and paratyphoid, strepto- and staphylococcal infections, and protozoan diseases including cysts of trophoxoites, trypanosomes and amoebic dysentry together with many other parasites.

Our Holy Prophet Mohammad (peace be upon him) declared that if a house fly happened to fall in any one's pot, it should be dipped completely in the food and then throw it away because it harbours the disease on one side and remedy on the other. According to this Holy Prophet, the flies carry microorganisms either pathogenic or non-pathogenic, and in the same time they may carry some factors that are antagonistic to these microorganisms, an enzymatic factors that cause lysis to pathogenic microorganisms, presence of organisms producing bacteriocius which are lethal to other microorganisms, ... etc. This condition is believed to be a kind of help from the Merciful God of human beings. Therefore, it was worthwhile to investigate these points.

The words given by our Prophet about the house fly attracted the attention of many religious specialists as well as muslim scientists and was a subject of a lot of arguments. The present study was carried out to find any difference of microbial counts between falling house flies in sterile water and milk without dipping the flies and falling house flies followed by dipping them in sterile water at pH 7 and 4. The study was made using a large number of replicates to be more confident and to reduce the natural variations in microbial load between different insects.

Material and Methods

1. *House Fly Samples*

Samples of house fly *(Musca domestica)* were collected from Jeddah and Makkah regions and transferred directly to the laboratory for microbiological analysis.

2. *Effect of Natural Falling and Dipping of the same House Fly on Microbial Contamination of Water*

The collected house flies were dropped one by one in sterile test tubes packed to about 2/3 of their volume with sterile cotton to reduce the depth.

To determine the effect of natural falling of house flies on the microbial load of sterile tap water, each tube containing the fly was opened opposite to another larger tube containing 10 ml sterile water. The fly reached the surface of the water and was left over it for 20 seconds, then removed. The microbial load was determined by plating on different media.

To determine the effect of complete dipping of house flies on the degree of microbial contamination of water, the tubes containing the same fly was opened against another containing 10 ml sterile tap water. After the fly reaches the water, it was completely dipped in it with the help of a special sterile inoculating needle. Dipping was made by two methods. In the first, the fly was dipped once for 20 seconds. In the second, the fly was dipped three times, 20 seconds each. In the last case, the corresponding natural falling was left for 60 seconds.

This experiment was made in natural sterile tap water (pH about 7), and in sterile water at pH 4. The microbial load of the contaminated water was determined directly after falling or dipping, then after 15, 30, 45 and 60 minutes from incubation of water at room temperature. The total microbial flora was determined on nutrient agar, and the non-haemolytic and haemolytic microflora were determined on blood agar[4].

3. *Natural Falling and Dipping of Separate House Flies*

The above mentioned technique described in the previous study was applied here. The only difference was that different house flies were used in natural falling and dipping treatments.

4. *Effect of Natural Falling and Dipping to House Fly on Microbial Contamination of Milk*

In another series of experiments, sterile milk was subjected to natural falling and dipping of the house flies. The microbial load of the milk was determined after its incubation at room temperature for 3 hours.

Results and Discussion

1. *Effect of Natural Falling and Dipping of the same House Fly on Microbial Load of Water*

It is clear from data presented in Table 1 that total microbial flora, non-haemolytic and haemolytic microorganisms showed a progressive sharp decline during 60 minutes incubation at room temperature. This reduction in count was, however, more evident on water at pH 4.0 than at pH 7.0.

It was also evident that most cases of dipping treatments, showed lower microbial densities than their corresponding natural falling treatments. Although dipping of fly in water is expected to result in higher contamination than natural falling, yet the present results showed a reverse data. This indicates that there are some antimicrobial factors released from the insect in the water, during dipping treatments. The collected flies could carry microbial flora which varied widely from insect to another both qualitatively and quantitatively. Some of them may resist the antimicrobial factors which is expected to be present on the flies. This may explain the higher counts observed in some dipping treatments.

2. *Effect of Natural Falling and Dipping of Separate House Flies on the Microbial Load of Water*

In the previous group of experiments, natural falling and dipping treatments were made on the same house fly. A considerable number of the microbial flora on the insect surface is washed off during falling on the surface of the water. Thus, when the same fly was tested by dipping it will carry less amount of microbial flora. In addition, if the fly carries antimicrobial factors on its surface a part of this factor is released in the water during natural falling treatment. This depends on how much the insect struggled, and on the period of dipping. Thus, the amount of the antimicrobial factors released in dipping treatment of the same insect, is expected to be unstable.

TABLE Effect of natural falling and dipping of house fly in sterile water on counts of total bacterial flora, non-haemolytic and haemolytic microorganisms (counts/ml)*.

Incubation Period (min)	pH of water	Total microbial flora				Non-haemolytic bacteria				Haemolytic bacteria			
		Natural falling	Dipping once	Natural falling	Dipping three	Natural falling	Dipping once	Natural falling	Dipping three	Natural falling	Dipping once	Natural falling	Dipping three
0	7.0	1950	1530	2625	2700	270	735	978	750	105	68	1350	849
15	(Natural)	1288	1208	1827	1343	311	288	776	567	63	93	524	734
30		1144	808	1291	1036	184	256	612	510	44	32	543	288
45		297	450	1131	1338	68	108	507	390	14	23	324	418
60		-	-	729	1034	-	-	297	278	-	-	432	368
0		1575	525	3900	4200	135	38	1260	405	293	375	75	780
15	4.0	1163	334	3626	1850	242	138	575	851	127	92	-	161
30		192	144	4556	1632	180	60	320	-	72	120	40	32
45		77	54	1922	1016	41	23	180	249	32	20	80	8
60		50	30	1342	1854	20	12	38	54	20	10	8	8

*Mean of five replicates.
Time of natural falling and dipping once is 20 seconds.
Time of natural falling and dipping three times is 60 seconds.

Therefore, in the following study two separate house flies were used for natural falling and dipping.

It is clear from the data presented in Table 2 that the total microflora non-haemolytic and haemolytic microorganisms showed progressive decline in all treatments after the incubation of the contaminated water for 60 min at room temperature. As previously mentioned, this sharp drop is an indication of the presence of an antimicrobial factor. It is also clear from these data that dipping once in water at neutral pH did not show any reduction in the microbial load. The total microbial counts were higher in dipping once treatments as compared to those of natural falling. However, when the microflora was determined after dipping three times and compared to those of natural falling and dipping once treatments, the results showed that the microbial loads in dipping 3 times treatments were considerably lower than those for natural falling and dipping for one time. This unexpected result may support the hypothesis of antimicrobial factor, which assumes that dipping three times ensures the release of high amount of this factor in the water.

In the case of water at pH 4.0, on the other hand, both dipping once and dipping three times treatments gave lower counts than natural falling treatments with only few exceptions. This may also indicate that the antimicrobial factor is more effective at pH 4.0.

When this study was made using a large number of replicates to be more confident and to reduce the natural variation in microbial load between different insects, results in Tables 3 and 4 indicated that the microbial load either non-pathogenic or pathogenic microorganisms showed a considerable calculation from fly to another either after falling or dipping in sterile water. It is also evident from data that these microflora are affected by dipping treatments, where dipping treatment gave lower

TABLE 2. Effect of natural falling and dipping of separate house flies in sterile water on counts of total microbial flora, non-haemolytic and haemolytic microorganisms (Count/ml)*.

Incubation Period (min)	pH of water	Total microbial flora			Non-haemolytic bacteria			Haemolytic bacteria		
		Natural falling	Dipping once*	Dipping three	Natural falling	Dipping once	Dipping three	Natural falling	Dipping once	Dipping three
0	7.0 (Natural)	360	1340	510	340	710	180	40	110	80
15		512	1112	376	168	592	240	79	32	64
30		240	450	96	216	234	96	30	42	8
45		192	450	96	104	348	16	8	52	8
60		84	232	30	42	148	10	10	2	8
0	4.0	3399	2100	3699	2700	2100	2499	949	949	499
15		4927	2089	3168	–	1099	1275	–	439	660
30		3039	2089	1215	1177	912	1368	342	417	351
45		864	591	2928	1471	1440	1248	639	480	624
60		–	909	1377	1507	–	850	259	–	273

*Mean of five replicates.
Time of natural falling and dipping once is 20 seconds.
Time of dipping three times is 60 seconds.

counts than those reported for natural falling samples. It may denote that although dipping has an inhibitory effect on the microbial flora as a whole, yet is probable that pathogenic microorganisms are more liable to this retarding effect. This is in harmony with the saying of the Holy Prophet of Islam concerning the effect of complete dipping of house fly on antagonising the disease.

TABLE 3. Changes in total microbial flora, non-haemolytic and haemolytic microorganisms counts as influenced by natural falling and dipping of house flies in sterile water at natural pH 7.

Sample No.	Mean count of (Counts/ml)								
	Total microbial flora			Non-haemolytic bacteria			Haemolytic bacteria		
	Falling	Dipping	% of change	Falling	Dipping	% of change	Falling	Dipping	% of change
1	413.3	70.0	–83.1	218.3	35.0	–79.4	36.6	3.3	–90.9
2	100.0	8.0	–91.7	173.3	48.3	–72.1	16.6	3.3	–80.1
3	1240.0	277.5	–77.6	2162.5	305.0	–85.9	41.6	25.0	–39.9
4	70.0	56.6	–19.1	75.0	43.3	–42.3	11.6	3.3	–71.6
5	228.0	61.6	–73.0	86.6	30.0	–65.4	5.0	1.6	–68.0
6	83.0	123.3	+48.0	15.0	30.0	+100.0	3.3	3.3	0
7	228.0	68.0	–70.1	216.6	125.0	–42.5	8.3	3.3	–60.2
8	361.6	181.6	–49.8	196.6	188.3	–4.2	13.3	18.3	+37.6
9	258.3	391.6	+51.6	193.3	225.0	+11.2	11.6	21.6	+46.3
10	131.6	76.0	–46.8	400.0	65.0	–83.7	108.3	10.0	–90.7
11	593.3	170.0	–71.3	688.3	186.6	–72.9	93.3	45.0	–51.8
12	38.3	191.6	+403.4	35.0	300.0	–757.1	6.6	33.3	+404.5
13	3.6	6.6	+83.3	51.6	10.0	–80.6	16.0	1.6	0
14	38.3	48.3	+26.1	137.5	175.0	+27.3	0	10.0	+
15	61.6	86.6	+40.6	153.3	153.0	0	0	26.6	–
16	893.3	823.3	–7.8	901.6	821.6	8.0	115.0	126.6	10.0

TABLE 4. Changes in total microbial flora, non-haemolytic and haemolytic microorganisms counts as influenced by natural falling and dipping of house flies in sterile water at pH 4.0.

Sample No.	Mean count of (Counts/ml)								
	Total microbial flora			Non-haemolytic bacteria			Haemolytic bacteria		
	Falling	Dipping	% change	Falling	Dipping	% change	Falling	Dipping	% change
1	233.3	268.3	+20.2	460.0	503.3	+9.4	71.6	78.3	+ 9.3
2	275.0	111.3	-59.4	325.0	88.3	-78.9	25.0	33.3	+33.2
3	853.3	858.3	+0.5	296.6	126.6	-57.3	105.0	48.0	-61.9
4	293.3	200.3	-31.8	198.3	85.0	-57.1	56.6	16.6	-70.0
5	578.3	543.3	- 6.1	180.0	126.6	-29.7	40.0	35.0	-12.6
6	713.3	690.0	-2.5	413.3	340.0	-17.7	80.0	36.6	-54.2

3. *Effect of Natural Falling and Dipping on Microbial Flora of Milk.*

It is clear from the data presented in Table 5 that natural falling of house fly in sterile milk resulted generally in a higher level of contamination of milk with different microorganisms compared to complete dipping of insects. It is expected that in dipping treatments, higher numbers of microorganisms are washed out from the insect surface than in natural falling treatments, and, consequently, higher levels of microbial densities would be recorded in dipping treatment. This was in contrast to our results. This suggests that the house fly may contain some antimicrobial factor or factors.

TABLE 5. Counts of total microbial flora, non-haemolytic and haemolytic microorganisms as influenced by falling and dipping of house flies in sterile milk, counts/ml (17 samples).

Microflora	Falling		Dipping	
	Total	mean	Total	mean
Total microbial flora	13440	790.6	2805	165.0
Non-haemolytic bacteria	12910	759.4	4250	250.0
Haemolytic bacteria	3790	222.9	715	42.1

4. *Effect of Natural Falling and Dipping of House Flies in Milk on the Growth of Contaminated Microorganisms*

The previous data suggest the probability of the presence of antimicrobial factors on the house flies. Thus, it was thought that the incubation of contaminated milk from the flies for a reasonable time at room temperature may take the effect of this factor more clear. In this experiment, the contaminated milk, after natural falling and dipping treatments, was incubated at room temperature and the microbial flora was counted after 0, 1, 2, and 3 hours incubation.

From data presented in Table 6, several points can be observed. Firstly, the means of bacterial counts after falling and dipping treatments at different incubation periods showed that dipping treatments gave considerably lower value. Secondly, although milk is well-known to be an excellent medium for the proliferation of many microorganisms, yet many samples of contaminated milk, either after falling or dipping treatment, showed progressive decline in counts. These observations support the suggestions of the presence of antimicrobial factors on the house fly.

TABLE 6. Effect of incubation period on the counts of different microorganisms in contaminated milk with natural falling and dipping house flies (counts/ml).

Microflora	Falling				Dipping			
	Incubation period (hr)				Incubation period (hr)			
	0	1	2	3	0	1	2	3
Total microflora								
1 – Total	3660	4620	5200	8420	2640	2200	3800	5840
2 – Mean	366	462	520	842	264	220	380	584
Non-haemolytic bacteria								
1 – Total	4180	3520	3620	4640	3020	2740	3600	3360
2 – Mean	418	352	362	464	302	274	360	336
Haemolytic bacteria								
1 – Total	800	720	2480	1360	440	640	1520	1080
2 – Mean	80	70	248	136	44	64	152	108

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تأثـــير السقوط الطبيعي والغمس للذبابـــة المنـــزلية على درجة التلوث الميكروبي لكل من المـاء والحليب

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درس في هذا البحث تأثير السقوط الطبيعي للذبابة المنزلية على سطح المـاء وكذلك غمسها مرة أو ثلاث مرات على درجة تلوث الماء المعقم . وقد أجريت هذه الدراسة على ماء طبيعي معقم ، وعلى ماء معقم ذي درجة حموضة (٤) قريبة من حموضة المعدة . وقد أوضحت النتـائج حدوث انخفـاض حاد في العـدد الكـلى للميكـروبات خلال ستين دقيقة من التحضين . وأظهرت معاملات غمس الذبابة المنزلية انخفاضاً واضحاً في درجة تلوث المـاء المحمض لدرجة حموضة ٤ ، مقارناً بالمـاء الطبيعي . وقد لوحظ تكرار هذا الاتجاه في حالة الميكروبات المحلَّلة وغير المحلَّلة لبيئة آجار الدم . كما أن غمس الذبابة المنزلية ثلاث مرات أدى إلى خفض التلوث الميكروبي عما لو غمست مرة واحدة .

كذلك وجد أن الغمس الكلي للذبابة في الحليب أنقص عدد الميكروبات ونموها . وهذه نتيجة مخالفة للمنطق ، إذ من المفروض أن يزيد عدد الميكروبات مع غمس الذباب فيما لو تم استبعاد وجود أية مادة أو عامل يقلل من عدد أو نمو الميكروبات . وتشير هذه النتيجة إلى وجود مادة أو مواد مضادة للجراثيم على جسم الذبابة .