Using garlic as a dog-flea repellent for the skin disease treatment

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ABSTRACT

Irritation with flea is one of the main cause in relevant to dog healthy. The aim of this study was to use garlic as a repellent for getting rid of those parasites. Four hundred grams of garlic crushed in fresh preparations were dropped onto the ground in the area (3 ½ X 2 Feet) of each dog-raising every other day in the 1st week, two other day in the 2nd, 3rd week and three other day in the 4th week. Three dogs (mixed breed, gender, similar age), large (30 kg), medium (12 kg) and small (8 kg) –sized, raised in the same environment were used in the experiment. Number of fleas, levels of skin appearances and levels of hair proliferation (the both latter designed in five categories) were recorded on each area of each animal and evaluated by statistical analysis**.** In the first week, The number of fleas on the medium-sized and the large-sized dogs were mostly on the head/face, neck, middle back, left body, right body and the tail, whereas the four limbs had lesser of them. There was a reducing pattern of the number of parasites starting from the 2nd time of 1st week (neck, back, metacarpus) then much reduced in the 3rd time of the 1st week (both front and hind limbs) and the 2nd week (head/face) until to the 6th week (neck, left front limb) ($p<0.05$). However, the small-sized dog had very few number of fleas comparing to those of the other two ($p<0.01$). The tails had more or less of number of fleas during the experiment and had a difficult tendency to decrease the number of fleas in the 10th week ($p<0.05$). For the skin appearance, it was found that the small-sized dog had the worst of it (4th, 3rd and 2nd level); severe inflammation in the head/face, neck, body and limbs, meanwhile, the medium-sized and large-sized dogs had only the 1st-2nd and the 0-1st level of skin lesion, respectively**.** This might be that the small-sized dog had an allergy to the flea and showed this impact in severity. Nevertheless, the skin lesion had a decreasing pattern similar to that of number of fleas. The lower the number of flea was, the better the skin appearance showed. This was clearly seen in the 2nd, 3rd time of the 1st week (on the neck) ($p<0.01$), and apparently appeared in the 2nd (back, left body) ($p<0.05$) and the 6th week (the right body) ($p<0.01$). Similar result occurred to the hair proliferation; the hair on all of the most areas (head/face, neck, middle back, body, four limbs, feet and tail) slowly growing up in the 3rd time of the 1st week, then apparently appearing in the 2nd and 6th week ($p<0.01$) and finally nearly fully grown up hair occurring in the 10th and 16th week. The result indicated that the flea (both larva and adult) died because of close attach to the garlic, then the skin was in repair process and hair proliferation occurred. It was concluded that garlic could be used as repellent for flea control and treatment of skin disease in the 6th to the 10th week.

Keywords: Garlic, Flea, skin disease

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Introduction

Flea is one of the most annoy parasite that cause so much itching to the dogs and cats. Irritation with flea is one of the main causes in relevant to dog and cat healthy. Adult fleas spend most of their lives on the skin of the host, sucking the blood, then female laying the eggs up to 20 eggs per each time on the ground and on the animal itself, as well. During its life-time, it can have 400 eggs per its life time. Mostly the eggs on the ground can have full development of their life cycles. After two days to two weeks hatching, the first larvae quickly become second larva (the maggot) crawling 1-2 weeks, then changing to cocoon (or pupae) and molting to be adult in 10-17 days or longer than that [1]. Only feeding with blood, adult can survive. Therefore, with the two strong hind legs they jump to the animal and still there, till they die [2]. Piercing mouth part of this parasite can cause deep penetration to the skin for blood sucking. Simultaneously, saliva and toxin are released to the animals causing so much irritation, itching, scratching and unrest to them. Moreover, allergy occurs in some dogs and cats [3].

From the previous studies, some chemicals such as organophosphates and carbamates were more often used for flea treatment. Nowadays, Fluocyanobenpyrazole, selamectin are now being used. Many studies tried to make a natural recipe from pyranthrin, citrous oil. However, there was a report showing some toxic effect or dangerous point of those things to the animal. Garlic, the ordinary spices in the kitchen, has a capable of antibacterial, fungicidal effect and may be used as a flea repellent in dogs.

The purpose of this work is to use garlic crushed in fresh preparations, as a repellent for flea treatment and control.

Materials and Methods

Three dogs (mixed breed, 7-10 years), large (30 kg) male, medium (12 kg) and small (8 kg) – sized females, raised in the same environment were used in the experiment. All dogs had flea infestation 2 weeks before starting the experiment. Four hundred grams of garlic crushed in fresh preparations were dropped onto the ground in the area (3 ½ X 2 Feet) of each dog-raising every other day in the 1st week, two other day in the 2nd, 3rd week and three other day in the 4th week. Then, let the fleas jumping down from the dogs onto the ground to lay eggs according to their natural way of life cycle. Those adult fleas contacting to the garlic on the ground died and also the second larva which later hatching from the eggs might contact to the garlic, then died, as well. Both of these appearances would cause reduction of the number of flea on the dog itself and the skin might be better because of healing process. Therefore, the areas on each dog were designed for counting the number of fleas, for evaluation of skin damage (so-called skin appearance) caused by flea and for evaluation of progression of healing process of skin (by hair proliferation). For skin appearance, four levels of inflammation and vesicles / eruption with red erythema were designed as follows: (Categories for skin appearance)

Level 0 = no lesion

Level 1 = slight lesion with inflammation and vesicle / eruption 25%

Level 2 = more inflammation and vesicles / eruption with red erythema 50%

Level 3 = more inflammation and vesicles / eruption with red erythema 75%

Level 4 = more inflammation and vesicles / eruption with red erythema 100%

For hair proliferation, the number of newly grown-up hair was counted and designed as five levels as follows:

Level 0 = no newly grown-up hair

Level 1 = less than 100 newly grown-up hairs

Level 2 = 100-300 newly grown-up hairs

Level 3 = 301-500 newly grown-up hairs

Level 4 = more than 500 newly grown-up hairs

Then, each area of the dog was given the mark or the level as designed above for skin appearance depending on the severity of skin damage and also for the number of newly grown-up hair (hair proliferation) depending on progression of healing process. All the areas of each animal were examined as the followings: head/face/ear, neck, middle back, left body, right body, left front limb, right front limb, left hind limb, right hind limb, left metacarpus, right metacarpus, left metatarsus, right metatarsus, left front foot, right front foot, left hind foot, right hind foot and tail. Number of fleas, levels of skin appearance and levels of hair proliferation on each area of each dog were recorded and evaluated by statistical analysis.

Results and Discussions

In the first week, the medium-sized and the large-sized dogs had the range of 10-68 flea in each area, then the number of parasites started to decrease in the 2^{nd} time of the 1^{st} week (neck, back, metacarpus) and much reduced in the 3^{rd} time of the 1^{st} week (both front and hind limbs) and the 2^{nd} week to the 6^{th} week. However, the small-sized dog had the least number of fleas. For the analysis, number of fleas (on the area: middle back, right body, tail) on each dog especially on the smallest-sized dog were highly significant different from those of the other two ($p<0.01$). Other areas (head/face, neck, left body, left & right hind limbs) of this dog and four areas (left and right metatarsus & hind foot) of the medium-sized dog also showed the significant differences in number of fleas ($p<0.05$). There was a reducing pattern of number of fleas clearly seen ($p<0.05$) in the 2^{nd} week (head/face), the 6^{th} week (neck, left front limb) and the 10^{th} week (back, right body) whereas the area of left body and right front limb gave highly significant reductions in the 6^{th} week and the 2^{nd} week, respectively ($p<0.01$). The number of fleas were much reduced in the area of left and right metacarpus from the 2^{nd} time of the 1^{st} week treatment till the end ($p<0.05$), however, both hind limbs, metatarsus and all four feet did not show the differences. The number of fleas on the tail appeared increasing and decreasing during the experiment then decreased all in the 10^{th} week ($p<0.05$) (Table 1).

The small-sized dog showed more skin lesions (in the 4^{th}, the 3^{rd}, the 2^{nd} level) and severe inflammation (in the head/face, neck, back, left & right front & hind limbs) than the other two whereas the medium-sized dog appeared only the 1^{st}, the 2^{nd} level of skin appearances in the same area and the large-sized animal had a slight skin inflammation showing the 0-1^{st} level. This was confirmed that skin appearances in all areas of three dogs giving highly significant and significant differences. Similar to the reducing pattern of the number of fleas, the skin lesion and inflammation of the small-sized and medium-sized dogs slowly decreased in the 2^{nd} time of the 1^{st} week (on the neck) ($p<0.01$), the 2^{nd} week (back, left body) ($p<0.05$), the 6^{th} week (the right body)($p<0.01$), the 10th week (the tail)($p<0.01$) (Table 2).

Hair proliferation of each area in all dogs showed highly significant differences, moreover, the hair was much well grown up in most areas of dogs in the 3^{rd} time of the 1^{st} week, the 2^{nd}, the 6^{th} , the10^{th} week ($p<0.01$) and the area of metacarpus and all four feet ($p<0.05$) (Table 3).

From the above data, it was clearly seen that the number of fleas were mostly on the head/face, neck, middle back, left body, right body and the tail, whereas the four limbs had lesser of the fleas. Comparing to the other two, the small-sized dog had few number of fleas. After the experiment had started, the number of fleas quickly reduced in the 2^{nd}, the 3^{rd} time of the 1^{st} week in the five-earlier mentioned areas including all four limbs. The reducing pattern was clearly shown in the 2^{nd} and the 6^{th} week, in addition, the four paws (left and right metacarpus and metatarsus and feet) included (Table 1). The tail had more or less of number of fleas during the experiment and had a difficult tendency to decrease the number of fleas. This indicated that the flea was likely to live on the tail more than other areas. It was corresponded with the literature [2] that usually the fleas live on the hind limbs and especially the uppermost of the tails of the animals which can be found most of the eggs there.

For the skin appearance, it was found that the small-sized dog had the worst of it (the 4^{th}, the 3^{rd} and the 2^{nd} level), severe inflammation in the head/face, neck, body and limbs, meanwhile, the medium-sized and large-sized dogs had only the 1^{st}-2^{nd} and the 0-1^{st} level of skin lesion, respectively. This might be that the small-sized dog had an allergy to the flea and showed this impact in severity. Nevertheless, the skin lesion had a decreasing pattern similar to that of number of fleas. The lower the number of fleas was,

the better the skin appearance showed. This was clearly seen in the 2nd, the 3rd time of the 1st week and more evident in the 2nd and the 6th week (Table 2). Similar result occurred to the percentages of hair proliferation, the hair on all of the most area (head/face, neck, middle back, body, four limbs, feet and tail) slowly grew up in the 3rd time of the 1st week, apparently appeared in the 2nd and the 6th week and nearly fully grown up in the 10th and the 16th week. Comparing to the other two, the small-sized dog which showed sign of allergy seemed to have the slowest grown up of hair proliferation. At the starting point, the hair nearly 100% loss in all areas of the whole body, then it had slowly grown up in the 6th week and much more grown up to 60%-70% in the 10th week and 90% in the 16th week (Table 3). The hairs on the tail of the medium-sized and small-sized dogs were the slowest grown up, comparing to those of the others. Again, this was insisted that the uppermost of the tail of the animal was the favorite area for the flea. Once the flea on the skin, it sucks the blood and this cause irritation, itching on the dog which responds to scratch on itself all day and night in order to get rid of the parasite. This results to inflammation and lacerated wound with some debris occurring on the skin which could be apparently seen in the all three dogs especially on the small-sized dog. However, this dog seemed to have allergy to the flea due to the severe responsiveness in accordance with literature [4]. During the 2nd to the 3rd time of the 1st week it was imagined that when the adult fleas on the ground attached to the garlic (fresh preparations) they might die because of parasiticidal effect of allicin in it. Therefore, the second larva/the pupa/the cocoon on the floor and the adult falling from the animal die, they decreased in number. This was clearly appeared in the 2nd and the 6th week of the experiment that the numbers of fleas were much more reduced oppositely to the skin appearances being much more improved. After the flea died, the wound was healed and the skin was in repairing process. Then the hair was slowly grown up during this time and fully grown up hairs were nearly accomplished in the 10th and the 16th week.

As already known that, many chemical drugs or pesticides have been used nowadays, nevertheless so much toxicity was still reported. For example, Fluocyanobenpyrazole is settled in class II WHO as a moderately hazardous pesticide and has LD50 of 97 mg/kg for oral route in acute toxicity [5]. Typical side effect of Fluocyanobenpyrazole in dog is redness on skin and irritation, nervous signs, convulsions abnormal gait and body twitches included [6]. Selamectin, another topical parasitcide used for flea prevention in dogs and cats, can also have less than 1% side effects following treatment such as transient localized alopecia with or without inflammation at or near the site of application in cats, in addition, post-approval experiences in dogs concern pruritus, urticaria, erythema, drooling, tachypnoea, lack of coordination, uscle tremors, seizures, anorexia, lethargy, fever, vomit or diarrhea with or without blood [7] [8].

Based on chemical drug toxicity, other concepts of so many natural recipes for flea control, pyrethrin, citrous oil and also garlic had been trialed out. Garlic, the so much well known spicy composes of allicin derived from alliin (S-allyl-l-cysteine sulfoxide) and other disulfide compounds showing the antibacterial and antifungal activities [9]. However, allicin would be melted due to heat during cooking period which its special odor had taken away [10]. At present, garlic is commonly used as insecticide, fungicide for human ringworm treatment and bactericide in the intestine. It can also have anti-inflammatory effect and capable of being used to reduce blood cholesterol (decrease LDL) and blood glucose meanwhile it is useful for increasing HDL, instead [11]. There were so many reports about using garlic for prevention of common cold and for lowering the risk of stomach cancer, prostate cancer, as well [12],[13]. The other two reports revealed the use of garlic in the treatment of generalized demodectic mange in a dog [14] and for the lacerated wound treatment and unknown skin disease in dogs [15]. This study was corresponded to that of Makowski [16] that the garlic was ingested by the dog, one to three fresh cloves, pulverized and mixed with food once a day, another suggestion from [17] 10-15 lb dog = ½ daily or 20-40 lb dog =1 clove daily giving the flea away from the dog. However, Garlic crushed in fresh preparations contained sulfur compounds such as ajoene, allyl polysulfides and vinyldithiins [18] which could evaporate and have pungent smell reaching to the bloodstream and lung. This would probably cause unsatisfaction for some dogs. Apart from that, the literature [19] said garlic contained thiosulphate which might cause “Heinx Factor” or haemolytic anemia in dogs that might be the cause of death of some dogs by garlic administration. Though, there might be some side effects from the use of garlic, these have never been approved by FDA [20]. Comparing to the dose, the amount of garlic used for repellent in this work may be 40 times more than ingestion. None of the adverse effect was found in this study. It

may be said that garlic in the external use for flea repellent in dogs would be safer than ingestion and could be thrown the flea away in the 6th to the 10th week including the treatment of dermatitis.

Conclusion

The result indicated that garlic crushed in fresh preparations could be used as an external repellent for flea treatment and control. No side effect was found in this study. This work may be the first study of external use of garlic as flea-repellent for treatment of skin disease.

Table 1 Number of Flea

Date	Head/ Face/ ear		Neck		Middle back		Left body		Rt body		Lt Front limb		Rt Front limb		Lt Hind Limb	
1st time 1st wk	13.7	a [2/]	17.7	a	26.7	a	20.0	a	12.3	a	13.0	a	6.7	ab	11.3	
2nd time 1stwk	10.7	ab	3.3	ab	9.7	ab	15.0	ab	20.3	a	5.3	ab	8.3	a	14.0	
3rd time 1st wk	7.0	a-c	10.3	ab	30.0	a	11.0	a-c	14.7	a	5.3	ab	6.3	ab	7.7	
2nd wk	1.7	bc	5.0	ab	23.0	a	23.0	a	15.0	a	2.7	ab	1.3	bc	4.3	
6th wk	1.3	bc	1.7	b	6.3	ab	2.3	bc	3.3	ab	0.0	b	0.0	c	1.7	
10th wk	0.0	c	0.0	b	0.0	b	0.0	c	0.0	b	0.0	b	0.0	c	0.0	
16th wk	0.0	c	0.0	b	0.0	b	0.0	c	0.0	b	0.0	b	0.0	c	0.0	
Sized dog																
Medium	8.4	a	6.6	ab	12.9	a	16.6	a	12.3	a	7.6		4.3		11.1	a
Small	0.7	b	0.4	b	0.6	b	1.1	b	0.6	b	1.3		1.1		0.1	b
Large	5.6	ab	9.3	a	27.6	a	12.9	a	15.3	a	2.4		4.3		5.4	ab
All average	4.9		5.4		13.7		10.2		9.4		3.8		3.2		5.6	
F-test [1/]																
Dogs	*		*		**		*		**		ns		ns		*	
Periods	*		*		*		**		*		*		**		ns	
C.V. (%)	55.7		63.1		62.5		48.3		49.7		54.5		46.4		67.6	

[1/] * and ** = significant at 5 % and 1 % levels.

[2/] The same letters in the column meaned did not significant at the level 5 % by DMRT.

Table 1 Number of Flea (continue)

Date	Rt Hind Limb		Metacarpus Lt		Metacarpus Rt		Metatarsus Lt		Metatarsus Rt		Lt front foot	Rt front foot	Lt Hind foot		Rt Hind foot	Tail	
1st time 1st wk	24.7		2.0	a[2/]	2.0	a	2.7		1.3		2.3	2.0	1.7		1.0	15.7	ab
2nd time 1stwk	12.0		0.0	b	0.0	b	1.0		0.0		1.0	0.3	1.3		0.7	24.3	a
3rd time 1st wk	15.7		0.3	b	0.3	b	2.0		2.0		0.7	0.7	0.7		0.3	7.7	a-c
2nd wk	7.3		0.0	b	0.3	b	0.7		2.0		0.0	0.0	0.3		0.3	11.0	a-c
6th wk	0.0		0.0	b	0.0	b	0.0		0.0		0.0	0.0	0.0		0.0	2.3	bc
10th wk	0.0		0.0	b	0.0	b	0.0		0.0		0.0	0.0	0.0		0.0	0.0	c
16th wk	0.0		0.0	b	0.0	b	0.0		0.0		0.0	0.0	0.0		0.0	0.0	c
Sized dog																	
Medium	18.7	a	0.6		0.7		2.7	a	2.1a		1.3	0.9	1.7	a	1.0a	16.1	a
Small	0.1	b	0.0		0.0		0.0	b	0.1b		0.0	0.0	0.0	b	0.0b	0.0	b
Large	6.7	ab	0.4		0.4		0.0	b	0.0b		0.4	0.4	0.0	b	0.0b	10.0	a

All average	**8.5**	**0.3**	**0.4**	**0.9**	**0.8**	**0.6**	**0.4**	**0.6**	**0.3**	**8.7**
F-test [1/]										
Dogs	*	ns	ns	*	*	ns	ns	*	*	**
Periods	ns	*	*	ns	ns	ns	ns	ns	ns	*
C.V. (%)	**83.4**	**32.8**	**32.6**	**53.3**	**53.0**	**41.3**	**35.6**	**43.5**	**32.6**	**55.6**

[1/] * and ** = significant at 5 % and 1 % levels.

[2/] The same letters in the column meaned did not significant at the level 5 % by DMRT.

Table 2 Skin Appearance

Date	**Head/ Face/ ear**	**Neck**	**Middle back**	**Left body**	**Rt body**	**Lt Front limb**	**Rt Front limb**	**Lt Hind Limb**
1st time 1st wk	**1.7**	**2.0 a**	**2.0 a**	**1.3 a-c**	**1.0 ab**	**2.0**	**1.7a**	**1.3**
2nd time 1stwk	**1.0**	**1.0 b**	**1.0 bc**	**1.7 a**	**1.3 a**	**0.8**	**0.8ab**	**1.0**
3rd time 1st wk	**0.8**	**1.0 b**	**0.8 cd**	**1.3 ab**	**1.3 a**	**1.2**	**1.2ab**	**1.2**
2nd wk	**0.8**	**1.0 b**	**1.2 b**	**1.2 a-c**	**1.2 a**	**1.3**	**0.9ab**	**0.7**
6th wk	**0.5**	**0.4 bc**	**0.7 de**	**0.4 b-d**	**0.4 bc**	**0.4**	**0.3b**	**0.5**
10th wk	**0.2**	**0.2 c**	**0.5 e**	**0.3 cd**	**0.3 bc**	**0.2**	**0.2b**	**0.2**
16th wk	**0.2**	**0.2 c**	**0.5 e**	**0.2 d**	**0.2 c**	**0.2**	**0.2b**	**0.2**
Sized dog								
Medium	**0.7 b** [2/]	**0.8 b**	**1.1 b**	**1.1 a**	**0.8 b**	**1.0 a**	**0.9a**	**0.6b**
Small	**1.6 a**	**1.6 a**	**1.8 a**	**1.1 a**	**1.3 a**	**1.6 a**	**1.4a**	**1.2a**
Large	**0.0 c**	**0.1 c**	**0.0 c**	**0.5 b**	**0.4 c**	**0.0 b**	**0.0b**	**0.3b**
All average	**0.8**	**0.8**	**1.0**	**0.9**	**0.8**	**0.9**	**0.7**	**0.7**
F-test [1/]								
Dogs	**	**	**	*	**	**	**	**
Periods	ns	**	*	*	**	ns	*	ns
C.V. (%)	**19.9**	**13.3**	**15.3**	**19.0**	**13.6**	**24.6**	**21.1**	**19.9**

[1/] * and ** = significant at 5 % and 1 % levels.

[2/] The same letters in the column meaned did not significant at the level 5 % by DMRT.

Table 2 Skin Appearance (continue)

Date	**Rt Hind Limb**	**Metacarpus**		**Metatarsus**		**Lt front foot**	**Rt front foot**	**Lt Hind foot**	**Rt Hind foot**	**Tail**
		Lt	**Rt**	**Lt**	**Rt**					
1st time 1st wk	**1.7**	**0.3**	**0.7 a**	**0.7 a**	**1.0 a**	**0.3**	**0.3**	**0.3**	**0.7**	**0.7bc**
2nd time 1stwk	**0.7**	**0.3**	**0.7 a**	**0.7 a**	**0.7 ab**	**0.7**	**0.3**	**0.3**	**0.3**	**1.0ab**
3rd time 1st wk	**1.0**	**0.3**	**0.7 a**	**0.7 a**	**0.7 ab**	**0.3**	**0.3**	**0.7**	**0.3**	**1.0ab**
2nd wk	**0.7**	**0.3**	**0.7 a**	**0.7 a**	**0.7 a**	**0.3**	**0.3**	**0.7**	**0.7**	**1.2a**
6th wk	**0.3**	**0.0**	**0.0 b**	**0.0 b**	**0.0 b**	**0.0**	**0.0**	**0.2**	**0.2**	**0.8ab**
10th wk	**0.2**	**0.0**	**0.0 b**	**0.0 b**	**0.0 b**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2c**
16th wk	**0.2**	**0.0**	**0.0 b**	**0.0 b**	**0.0 b**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2c**
Sized dog										
Medium	**1.0 a**	**0.0 b**	**0.6 a**	**0.6 a**	**0.6 a**	**0.1 b**	**0.0 b**	**0.4 ab**	**0.4ab**	**0.8a**
Small	**1.1 a**	**0.6 a**	**0.6 a**	**0.6 a**	**0.7 a**	**0.6 a**	**0.6 a**	**0.6 a**	**0.6a**	**0.9a**

Large	**0.0 b**	**0.0 b**	**0.0 b**	**0.0 b**	**0.0**	**b**	**0.0**	**b**	**0.0**	**b**	**0.0**	**b**	**0.0b**	**0.5b**
All average	**0.7**	**0.2**	**0.4**	**0.4**	**0.4**		**0.2**		**0.2**		**0.3**		**0.3**	**0.7**
F-test [1/]														
Dogs	**	**	**	**	*		*		**		**		**	*
Periods	ns	ns	*	*	*		ns		ns		ns		ns	**
C.V. (%)	**22.3**	**19.4**	**17.3**	**17.3**	**20.9**		**21.1**		**19.4**		**22.2**		**22.2**	**11.2**

[1/] * and ** = significant at 5 % and 1 % levels.

[2/] The same letters in the column meaned did not significant at the level 5 % by DMRT.

Table 3 HAIR Proliferation %

Date	**Head/ Face/ ear**		**Neck**		**Middle back**		**Left body**		**Rt body**		**Lt Front limb**		**Rt Front limb**	**Lt Hind Limb**
1st time 1st wk	**40.2**	**b**[2/]	**15.2**	**c**	**15.2**	**c**	**20.7**	**c**	**20.3**	**c**	**37.7**	**cd**	**37.3c**	**36.8c**
2nd time 1stwk	**37.5**	**b**	**18.4**	**c**	**19.0**	**c**	**18.3**	**c**	**22.7**	**c**	**24.3**	**d**	**38.3c**	**30.1c**
3rd time 1st wk	**49.2**	**b**	**22.3**	**c**	**24.7**	**bc**	**35.3**	**bc**	**32.7**	**c**	**42.3**	**cd**	**47.5c**	**30.1c**
2nd wk	**49.0**	**b**	**30.7**	**c**	**33.7**	**bc**	**41.7**	**b**	**38.0**	**bc**	**44.3**	**cd**	**47.5c**	**33.4c**
6th wk	**70.0**	**ab**	**58.3**	**b**	**46.7**	**b**	**55.0**	**b**	**55.0**	**b**	**63.3**	**bc**	**65.0bc**	**60.0b**
10th wk	**88.3**	**a**	**86.7**	**a**	**83.3**	**a**	**80.0**	**a**	**80.0**	**a**	**83.3**	**ab**	**85.0ab**	**80.0ab**
16th wk	**96.7**	**a**	**96.7**	**a**	**90.0**	**a**	**90.0**	**a**	**91.7**	**a**	**93.3**	**a**	**98.3a**	**91.7a**
Sized dog														
Medium	**67.1**	**b**	**49.3**	**b**	**52.9**	**a**	**58.6**	**a**	**61.4**	**a**	**63.6**	**a**	**64.3b**	**53.6b**
Small	**28.9**	**c**	**24.2**	**c**	**23.2**	**b**	**22.6**	**b**	**22.3**	**b**	**23.7**	**b**	**26.7c**	**20.2c**
Large	**88.6**	**a**	**67.1**	**a**	**57.9**	**a**	**65.0**	**a**	**62.1**	**a**	**79.3**	**a**	**88.6a**	**81.4a**
All average	**61.5**		**46.9**	**c**	**44.6**		**48.7**		**48.6**	**c**	**55.5**	**cd**	**59.9**	**51.7**
F-test [1/]														
Dogs	**		**		**		**		**		**		**	**
Periods	**		**		**		**		**		**		**	**
C.V. (%)	**27.4**		**32.0**		**26.6**		**22.7**		**19.7**		**25.0**		**28.7**	**24.3**

[1/] * and ** = significant at 5 % and 1 % levels.

[2/] The same letters in the column meaned did not significant at the level 5 % by DMRT.

Table 3 HAIR Proliferation % (continue)

Date	**Rt Hind Limb**	**Metacarpus**		**Metatarsus**		**Lt front foot**	**Rt front foot**	**Lt Hind foot**	**Rt Hind foot**	**Tail**
		Lt	**Rt**	**Lt**	**Rt**					
1st time 1st wk	**33.3c**[2/]	**51.0b**	**51.0b**	**30.1c**	**40.2b**	**55.3c**	**55.3b**	**50.2b**	**53.5b**	**24.5c**
2nd time 1stwk	**31.7c**	**54.3b**	**57.7b**	**33.4c**	**36.8b**	**56.0c**	**56.0b**	**50.7b**	**52.3b**	**23.5c**
3rd time 1st wk	**35.2c**	**56.8b**	**55.1b**	**33.5c**	**33.5b**	**55.2c**	**55.1b**	**48.5b**	**53.5b**	**24.2c**
2nd wk	**40.2c**	**57.3b**	**55.7b**	**36.8bc**	**41.8b**	**55.3c**	**55.7b**	**51.8b**	**51.8b**	**28.5bc**
6th wk	**59.3bc**	**65.0b**	**66.7b**	**54.0bc**	**54.0b**	**66.7bc**	**68.3ab**	**65.7ab**	**65.7ab**	**48.3bc**
10th wk	**83.3ab**	**75.0ab**	**78.3ab**	**66.7ab**	**85.0a**	**80.0ab**	**80.0ab**	**68.3ab**	**86.7a**	**61.7ab**
16th wk	**93.3a**	**96.7a**	**98.3a**	**90.0a**	**95.0a**	**90.0a**	**98.3a**	**93.3a**	**95.0a**	**85.0a**
Sized dog										
Medium	**53.6b**	**87.9a**	**87.9a**	**52.1b**	**60.0b**	**90.7a**	**90.7a**	**85.0a**	**89.3a**	**42.1b**
Small	**22.0c**	**19.1b**	**21.9b**	**11.2c**	**21.3c**	**17.2b**	**21.6b**	**12.9b**	**21.5b**	**10.3c**
Large	**85.7a**	**88.6a**	**88.6a**	**84.3a**	**84.3a**	**88.6a**	**88.6a**	**85.7a**	**85.7a**	**74.3a**
All	**53.8**	**65.2**	**66.1**	**49.2**	**55.2**	**65.5**	**67.0**			**42.2**

average								**61.2**	**65.5**	
F-test [1/]										
Dogs	**	**	**	**	**	**	*	**	**	**
Periods	**	*	*	**	**	*	*	*	*	**
C.V. (%)	**28.1**	**24.9**	**25.7**	**34.7**	**26.3**	**18.8**	**25.3**	**24.4**	**25.9**	**42.3**

[1/] * and ** = significant at 5 % and 1 % levels.
[2/] The same letters in the column meaned did not significant at the level 5 % by DMRT.

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