

Journal of the Hellenic Veterinary Medical Society

Vol 71, No 4 (2020)



A study on the use of henna plant (*Lawsonia inermis* Linn) for the treatment of fungal disease (*Trichophyton verrucosum*) in calves

H. HIZLI

doi: [10.12681/jhvms.25923](https://doi.org/10.12681/jhvms.25923)

Copyright © 2021, H. HIZLI



This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0](https://creativecommons.org/licenses/by-nc/4.0/).

To cite this article:

HIZLI, H. (2021). A study on the use of henna plant (*Lawsonia inermis* Linn) for the treatment of fungal disease (*Trichophyton verrucosum*) in calves. *Journal of the Hellenic Veterinary Medical Society*, 71(4), 2483–2490. <https://doi.org/10.12681/jhvms.25923>

A study on the use of henna plant (*Lawsonia inermis* Linn) for the treatment of fungal disease (*Trichophyton verrucosum*) in calves

H. Hizli

Mediterranean Agricultural Research Institute, Adana, Turkey

ABSTRACT. The aim of this study was to investigate the usability of henna plant (*Lawsonia inermis* Linn) in the treatment of dermatophytosis lesions (*Trichophyton verrucosum*) in cattle. The animal material of the trial consisted of 50 holstein calves between the ages of 4 and 6 months, who were found to have a dermatophytosis lesion on their face and neck in their clinical examination. The experiment was organized on a three-group repeated measurement trial plan. I. Group: Trichlorfon (Neguvon 75%, Bayer) ointment, II. Group: Henna applied, and III. Group: Control Group, no treatment, and 20 (10 females, 10 males), 20 (10 females, 10 males), and 10 (5 females, 5 males) totally 50 calves used, respectively. The research was continued for 14 days until the lesions were completely healed. I. and II. Groups were observed the best healing in the calves, respectively. In the III. Group without any treatment, there was no improvement and the lesions were enlarged. In addition, the effect of gender in the treatment process of dermatophytosis lesions was insignificant. As a result of this study, it is thought that henna plant can be used in the treatment of dermatophytosis.

Keywords: Dermatophytosis; *Trichophyton verrucosum*; Henna (*Lawsonia inermis* Linn); Repeated measurement; Ringworm

Corresponding Author:
Hatice Hizli, Doğu Akdeniz Tarımsal Araştırma Enstitüsü, Karataş Yolu 17. km
Doğankent mah. Yüreğir/Adana, Turkey
E-mail address: haticehizli@gmail.com

Date of initial submission: 25-12-2019
Date of revised submission: 09-06-2020
Date of acceptance: 14-06-2020

INTRODUCTION

Henna (*Lawsonia inermis* Linn) is one of the oldest and most popular plants known among medicinal plants and is a perennial shrub widely grown in North Africa (Solecki, 1975; Bhattacharjee and De 2003; Borade et al. 2011). Henna contains phenol compounds, naphthoquinone derivatives (mainly lawson), terpenoids, sterols, xanthines, aliphatic compounds, coumarins, carbohydrates, flavanoids, essential oils and other chemical components (Makhija et al. 2011; Santosh et al. 2013). Henna leaves contain a dense pigment called hennotannic acid (2-hydroxy-1,4-naphthoquinone) lawsone. This pigment has orange-red colorant properties and in studies conducted in different countries, it has been observed that naftokinone-derived dyes such as lawsone have antibacterial and antifungal activities (Jain et al. 2010; Rayavarapu et al. 2011).

It is used as an antifungal antibacterial compound since it contains *Cassia obovata* anthraquinones in henna leaf powder (Trease and Evans, 1983; Vaidya, 2000; Wallis, 2001). It has been reported that henna has antibacterial effects, antifungal activity against dermatophytes, wound healing, antitumoral effects, hypotensive, astringent and sedative effects, Henna has been reported by many researchers to have different healing effects, antibacterial effects especially for gram positive bacteria, antifungal activity against dermatophytes and wound healing (Berenji et al., 2010; Elmanama et al., 2011; Jain et al., 2010; Muhammad and Muhammad. 2005).

Dermatophytosis (Ringworm / dermatomycosis) is an infectious and zoonotic disease characterized by various lesions in many animal species and different parts of the body (Arda, 2006; Barbieri et al., 2017; Cabañes et al., 1997; Chermette et al., 2008; Sahal, 1994). *Trichophyton*, *Microsporum* and *Epidermophyton* are the three genera that cause dermatophytosis of fungal agents and there are many species within them. Many species of *Trichophyton* and *Microsporum* cause clinical infections in farm animals. The species known as *Trichophyton verrucosum* causes clinical infection especially in cattle (Yılmaz and Aslan, 2010; Şennazlı, 2018; Or and Bakirel, 2002). The infection caused by dermatophytosis in humans and animals is called “ringworm” or fungal in society (Wabacha et al., 1998; Weber, 2000).

Wagini et al., (2014) reported that together with henna, the fungitoxic effects of 13 species known as dermatophytes on 30 plant species were tested and

only the full toxic effect of henna was observed. In addition, Ponugoti, (2018) reported that aqueous extract of henna leaves were tested for antifungal potential against eight important *Aspergillus* species isolated from sorghum, corn and paddy seed samples, and petroleum ether, benzene, chloroform, methanol and ethanol extract of the plant showed significant antifungal activity. Ponugoti, (2018) reported this finding suggested that henna extract may be used as an alternative source of antifungal agent for the protection of fungal infection.

Başoğlu et al., (1998), Kırmızıgül et al. (2008a, 2009b, 2013c), Cam et al., (2009) reported that systemic antifungal and topical treatment were used for the treatment of wounds caused by dermatophytes. In a study has done with henna by Muhammed H and Muhammed S, (2005) reported that the mixture of powder henna leaves with water prevents the wound from growing in burns. Polat, (2014) reported that a stray dog that has two pecuniary lossy wound on applied a mixture of henna, butter and povidin iodide in certain proportions to the injured area and reported that the wound healed quickly.

This study was carried out to investigate the possibility of using henna in the treatment of dermatophytosis lesions in cattle.

MATERIAL AND METHODS

Ethical scope

This study was conducted in accordance with the principles of the Local Ethics Committee in the framework of the ethics confirmed by the Çukurova University Directorate of Local Ethics Committee of Animal Experiments (29.01.2018).

Fifty head Holstein Friesian calves aged between 4-6 months and with a live weight of 80-90 kg were used at the Eastern Mediterranean Agricultural Research Institute. I. Group: Trichlorfon (Neguvon 75%, Bayer) ointment was applied, II. Group: Henna slurry that obtained from the mixture of henna leaf powder with 1/2 ratio of water was applied, and III. Group, Control Group: calves was not applied any treatment, and 20 (10 females, 10 males), 20 (10 females, 10 males), and 10 (5 females, 5 males) totally 50 calves used, respectively. Calves were randomly distributed according to the wound size, and care and feeding were applied homogeneously in all Groups. In all Groups the lesions were brushed with a medium hardness brush before any treatment. For the initial

measurements of the experiment, the wound size was drawn on the acetate paper placed on the wound and then the size of the wound was calculated in mm² with the help of millimetric paper. In the III th Group only the lesions were measured by brushing every day, and since there was no improvement the trial was terminated on the 14th day when complete recovery was achieved in the I th, II th Groups.

Since each of the observations were obtained from the same experimental unit (calf) and included a period of time in terms of healing time. One-way analysis of variance was performed in the General Linear Model approach by the Repeated Measurement procedure in IBM SPSS 22. Differences in means between applications were compared by Tukey multiple comparison test statistic. In the analysis of variance, Mauchly's Sphericity test was used to ensure the validity of the F test. Greenhouse-Geisser, Huynh-Feldt, or Lower-bound corrections, which correct the degrees of freedom, were used to determine whether the differences between sphericity test and all dependent group combinations were equal (Box, 1954; Green-

house and Geisser, 1959; Huynh and Feldt, 1976).

RESULTS

Mauchly's Sphericity test was applied to the F-test to be valid in one-way analysis of variance of repeated measured data and it was found to be significant at (Table 1) ($P < 0.001$).

Thus, Greenhouse-Geisser, Huynh-Feldt or Lower-bound estimates, which corrected degrees of freedom, were used to interpret the ANOVA F test and The Analysis of Variance Table is divided into two sources as Test-Between-Subjects Effects, Test-Within-Subject Effects. As seen Table 2. Test-Between-Subjects effects of the variance analysis results the difference between the groups was statistically significant ($P < 0.0001$) and the difference between the genders was not statistically significant ($P > 0.05$). On the other hand, Test-Within-Subject Effects of The variance analysis results the days (recovery time of calves) and the interaction of the days and groups were statistically significant ($P < 0.0001$) and the results are shown in Graph 1 and Graph 2.

Table 1. Mauchly's Test of Sphericity^a

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon ^b		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Day	0.000	1784.546	90	0.000	0.117	0.128	0.077

Table 2. Repeated Measures Variance Analysis

Tests of Between-Subjects Effects						
Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept		290907	1	290907	225,021	0.000
Groups		102167,6	2	51083,81	39,514	0.000
Gender		168,894	1	168,894	0,131	0,719
Error		59468,83	46	1292,801		
Tests of Within-Subjects Effects						
Day	Sphericity Assumed	12341,96	13	949,381	14,602	0.000
	Greenhouse-Geisser	12341,96	1,526	8089,462	14,602	0.000
	Huynh-Feldt	12341,96	1,67	7389,194	14,602	0.000
	Lower-bound	12341,96	1	12341,96	14,602	0.000
Day * Groups	Sphericity Assumed	119904,8	26	4611,723	70,93	0.000
	Greenhouse-Geisser	119904,8	3,051	39295,45	70,93	0.000
	Huynh-Feldt	119904,8	3,341	35893,82	70,93	0.000
	Lower-bound	119904,8	2	59952,41	70,93	0.000
Day * Gender	Sphericity Assumed	341,519	13	26,271	0,404	0,969
	Greenhouse-Geisser	341,519	1,526	223,847	0,404	0,614
	Huynh-Feldt	341,519	1,67	204,469	0,404	0,632
	Lower-bound	341,519	1	341,519	0,404	0,528
Error(Day)	Sphericity Assumed	38880,62	598	65,018		
	Greenhouse-Geisser	38880,62	70,181	554,002		
	Huynh-Feldt	38880,62	76,832	506,044		
	Lower-bound	38880,62	46	845,231		

Differences between the groups were found with Tukey test statistics and the results were given in Table 3 and the best healing was seen in I th Group where Trichlorfon ointment was applied. This was followed by henna application II th Group. The mean, standard deviations, minimum and maximum values of fungal lesions according to treatment Groups and genders were given in Table 4.

Table 3. The means of trial groups comparison by Tukey test statistics

Groups	N	Mean	Std. Dev.	Std. Error
I. Group	20	7.49a	7.73	2.15
II. Group	20	16.50b	7.71	2.15
III. Group	10	40.47c	5.52	3.04

P < 0.05; I. Group: Trichlorfon; II. Grup: Henna; III. Group: Control

The results of I., II., III th Groups were used in the treatment in calves were shown in Table 4.

Table 4. Descriptive statistics of experimental groups in daily recovery process

	Female					Research Groups					I. Group			
	III. Group					II. Group					I. Group			
	N	Mean	±Ss	Min.	Mak.	N	Mean	±Ss	Min.	Mak.	Mean	±Ss	Min.	Mak.
1. day	5	20.1	7.34	12.8	30.2	10	33.68	21.71	12	80	34.14	21.2	11.25	70.3
2. day	5	20.76	7.69	13.5	32	10	33.68	21.71	12	80	30.4	21.2	9.3	66.5
3. day	5	21.68	7.5	15	33	10	32.71	21.65	11	78	22.3	17.8	2	57.4
4. day	5	22.86	8.08	16	35	10	30.67	21.73	9	75	14.79	15.4	0	48.2
5. day	5	24.54	8.39	17.5	37	10	27.43	20.96	6	70	8.38	11.5	0	35.3
6. day	5	26.34	8.79	19	40	10	23.38	19.57	4	61.5	3.85	7.02	0	22.5
7. day	5	31.2	8.26	23	43	10	18.53	16.93	2	50	1.24	3.02	0	9.4
8. day	5	37.78	8.58	28.9	47	10	14.5	15.11	0	43	0.32	1.01	0	3.2
9. day	5	43.2	10.38	33	58	10	10.92	12.26	0	33	0	0	0	0
10. day	5	48.3	12.33	38	66	10	6.75	8.37	0	20	0	0	0	0
11. day	5	55.5	15.26	44	79	10	3.3	4.52	0	12	0	0	0	0
12. day	5	63	18.06	47	91	10	1.6	2.41	0	7	0	0	0	0
13. day	5	72.32	26.47	47	115	10	0.3	0.67	0	2	0	0	0	0
14. day	5	79.5	32.94	48	133	10	0	0	0	0	0	0	0	0
	Male					Research Groups					I. Group			
	III. Group					II. Group					I. Group			
	N	Mean	±Ss	Min.	Mak.	N	Mean	±Ss	Min.	Mak.	Mean	±Ss	Min.	Mak.
1. day	5	17.38	7.36	10	26.3	10	33.65	18.18	11.3	65	32.05	16.2	15	62
2. day	5	18.05	7.83	10	28.3	10	33.61	18.23	11.3	65	25.85	17.5	8.5	58
3. day	5	19.27	8.97	10.5	32	10	32.95	18.07	11	65	18.4	16.6	2	50
4. day	5	20.8	8.91	13.2	34	10	30.6	17.86	9	63	11.37	13.2	0	37.7
5. day	5	22.84	10.12	14.6	38.6	10	27.1	17.27	6	59	5.1	6.89	0	20
6. day	5	25.86	12.3	15.8	45	10	22.1	16.38	3	52	1.3	2.36	0	7
7. day	5	28.3	13.45	17	49.5	10	16.9	14.69	1	44	0.3	0.95	0	3
8. day	5	33.05	13.6	21	53.3	10	12	12.33	0	36	0	0	0	0
9. day	5	39.96	10.05	29.8	54	10	8	9.45	0	27	0	0	0	0
10. day	5	47.2	10.16	35	61	10	4.6	6.1	0	18	0	0	0	0
11. day	5	56.2	11.69	43	69	10	2.2	3.52	0	10	0	0	0	0
12. day	5	66.2	11.52	51	79	10	0.7	1.64	0	5	0	0	0	0
13. day	5	77.6	14.36	58	97	10	0.2	0.63	0	2	0	0	0	0
14. day	5	93.4	20.53	65	123	10	0	0	0	0	0	0	0	0

(P < 0.0001); Grup I: Trichlorfon; Grup II: Henna; Grup III: Control

It was examined results that although, the mean lesion areas in both male and female calves increased in the III th Group. The healing process in the I th Group started on 2th day, the mean lesion areas continued to shrink and females recovered completely on the 9th day and, in males on the 8th day. In the II th Group, recovery started in males on the 2nd day, females on the 3rd day and finished on the 14th day completely. Also, no improvement was observed in the Group III

and lesions were enlarged. Lesion size increased during the 14-day period from 20.1 ± 7.38 mm to 79.5 ± 32.94 mm in females and from 17.38 ± 7.36 mm to 93.4 ± 20.53 mm in males. In experiment, triple interaction Groups x Gender x Recovery Time is shown in Graph 1. The effects (daily change) of Grup I, II, III applications on healing time throughout the trial are shown in Graph 2.

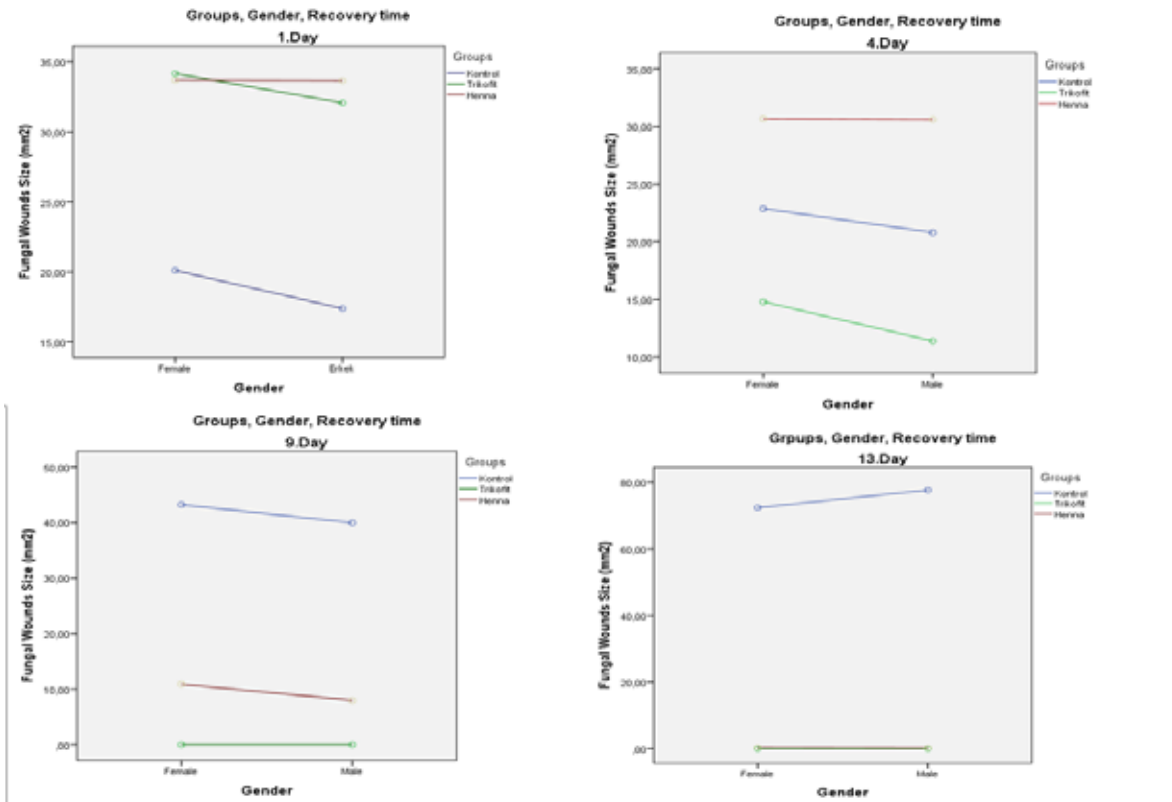


Figure 1. Change of interaction of group and gender

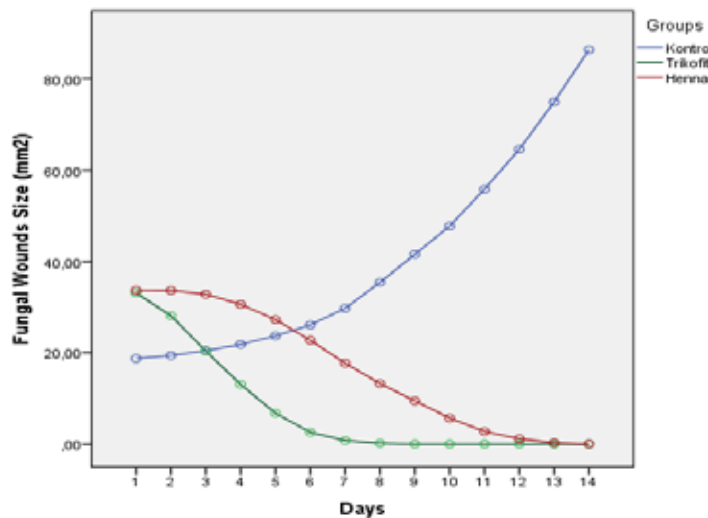


Figure 2. Distribution of the effects of groups on recovery time

DISCUSSION

The differences between the minimum and maximum values (mm^2) increase in the I. and II. Groups from the beginning of the recovery and cause the standard deviations to increase. In I th Group mean and standard deviation 8th day in females (14.5 ± 15.11), minimum and maximum values (0; 43) and, in males (12 ± 12.33) and (0; 36) as it has been realized. In II th Group mean and standard deviation 4th day in females (14.79 ± 15.4), minimum and maximum values (0; 48.2) and, in males (11.37 ± 13.2) and (0; 37.7) realized. The standard deviation was never greater than the mean because the wounds in the III. Group were constantly growing. Also, Başoglu et al., (1998) reported that 57 calves with 1-6 cm ringworm in the neck area applied henna slurry four times a month and reported that all calves healing at the end of one month. This result is similar to the results of this study in that the henna completely heals the fungal wounds in calves.

The results, reflected by Yılmaz and Aslan (2010) that effectiveness of using of neugvon and whitfield's ointment in the treatment of fungal disease in cattle were in agreement with the results of the present study and the application of trichophyte ointment. Additionally, Kırmızıgül et al., (2008, 2009, 2013) reported that the healing of dermatophytosis lesions started on day 3 and ended on day 7 completely. These findings were similar to the results of the present study. In the current study, improvement starts on the 4th day and ends on the 8th day. It is thought that the longer duration of the healing is due to the different wound size and the different feeding program applied and the different environmental conditions such as climate and season. Abdulmoneim, (2007) reflected that leaf samples of *Lawsonia inermis* examined their antimicrobial potentials by phytochemical analyzes and determined the presence of anthraquinones as the main component in henna leaves. As a result, since this condition is known to have antimicrobial activity in general, it has been reported that henna leaves have antibacterial, antifungal activity and can be used in the treatment of bacterial infections. Collected henna samples from different regions of Oman have been shown to have the highest antibacterial activity against *P. aeruginosa* organisms. During screening of barks of 30 plant species against *Microsporum gypseum* and *Trichophyton mentagrophytes*, only *Lawsonia inermis* Linn extract exhibited absolute toxicity, the leaves of *L. inermis* L. were also found to exhibit strong fungi toxicity and non-phytotoxicity reported

by Habbal et al. (2011). Lawsonia isolated from the leaves of *L. inermis* has shown significant antifungal antibiotic effects reported by Santosh et al. (2013). All these stated results were similar to the results of this study Also, Rahmoun et al. (2013) stated that henna was widely used on the skin and was clearly safe to use. In addition, Yadav et al. (2013) reported that henna plant and extract against *Microsporum gypseum* and *Trichophyton mentagrophytes* fungi, absolute toxicity, even in high temperature even if this toxicity stated that the activity continues. In addition, Kızılgül et al. (2008), Karpe et al. (2011) and Jamshidi-Kia et al. (2018) reported that dermatophytosis lesions started to heal on the 3rd day with different drugs and they completely healed on the 7th day. These findings were similar to the results of the present study.

In the present study, healing starts on the 2th day and ends on the 14th day and it is thought that the longer duration of the healing is due to different wound size and different feeding program, different environmental conditions such as climate and season.

CONCLUSION

Although the treatment of fungal disease in cattle (*Trichophyton verrucosum*) requires a slightly longer treatment period than synthetic medicine, it is thought that henna can be used instead of synthetic drugs, but further researches are needed on this subject.

ACKNOWLEDGMENTS

I would like to acknowledge to Professor Dr. Mikail BAYLAN, Aysun ÇAMLIDAĞ and Orhan Gazi DÜNDAR for their contributions during the conduct of the research.

CONFLICT OF INTEREST

None declared.

REFERENCES

- Arda M (2006) Mantarların genel karakterleri. Temel Mikrobiyoloji. Genişletilmiş 2. Baskı, Medisan Yayınevi, Ankara: pp 315-367.
- Barbieri R, Cooppo E, Marchese A, Daglia M, Sobarzo E, Nabani SM (2017) Phytochemicals for human disease: An update on plant-derived compounds antibacterial activity. Microbiological Research 196: 44-68.
- Başoğlu A, Birdane FM, Solmaz H (1998) The effect of henna (*folium lawsoniae*) paste in calves with ringworm. Indian Veterinary Journal 75 (1): 71-72.
- Berenji F, Rakhshandeh H, Ebrahimipour H (2010) In vitro study of the effects of henna extracts (*Lawsonia inermis*) on *malassezia species*. Jundishapur Journal of Microbiology 3(3):125-128.
- Bhattacharjee SK, De LC (2003) Medicinal herbs and flowers, Aavishkar Publishers and Distributors.
- Borade AM, Kale BN, Shete RV (2011) A phytopharmacological review on *Lawsonia inermis*. International Journal of Pharmacy and Life Sciences 2(1): 536-541.
- Box GEP (1954) Some theorems on quadratic forms applied in the study of analysis of variance problems. I. Effect of inequality of variance in the one-way classification. The Annals Mathematical Statistics 25 (2):290-302. <https://projecteuclid.org/euclid.aoms/1177728786> doi: 10.1214/aoms/1177728786
- Cabañes FJ, Abarca ML, Bragulat MR (1997) Dermatophytes isolated from domestic animals in Barcelona, Spain, Mycopathologia 137 (2): 107-113.
- Cafarchia C, Romito D, Sasanelli M, Lia R, Capelli G, Otranto D (2004) The epidemiology of canine and feline dermatophytoses in southern Italy. Mycoses 47 (11-12): 508-513.
- Cam Y, Gümtüşsoy KS, Kibar M (2009) Efficacy of ethylenediamine dihydriodide for the treatment of ringworm in young cattle. Vet Rec 24;160 (12): 408-10.
- Chermette R, Ferreira L, Guillot J (2008) Dermatophytoses in animals. Mycopathologia 166 (5-6): 385-405
- Elmanama AA, Alyazji AA, Abu Gheneima NA (2011) Antibacterial, antifungal and synergistic effect of *Lawsonia inermis*, *Punica granatum* and *Hibiscus sabdariffa*. Annals Alquds Medicine 7 (1432): 33-41.
- Greenhouse SW, Geisser S (1959) On methods in the analysis of profile data. Psychometrika 24: 95-112. <http://dx.doi.org/10.1007/BF02289823>
- Habbal O, Hasson SS, El-Hag AH, Al-Mahrooqi Z, Al-Hashmi N, Al-Bimani Z, MS Al-Balushi, Al-Jabri AA (2011) Antibacterial activity of *Lawsonia inermis* Linn (Henna) against *Pseudomonas aeruginosa*. Asian Pac J Trop Biomed 1(3): 173-176. doi:10.1016/S2221-1691(11)60021-X
- Heinrich M, Barnes J, Gibbons S, Williamson EM (2004) Fundamentals of Pharmacognosy and Phytotherapy, Churchill Livingstone, Edinburgh.
- Huynh H, Feldt L (1976) Estimation of the Box Correction for Degrees of Freedom from Sample Data in Randomized Block and Split-Plot Designs. Journal of Educational Statistics, 1(1): 69-82. doi:10.2307/1164736
- Imren HY, Sahal M (1994) Trikofiti. Veteriner İç Hastalıkları. Eds E. Alaçam, M. Sahal, 3. Baskı, Medisan, Ankara: pp 213-215.
- Jain VC, Shah DP, Sonani NG, Dhakara S, Patel NM (2010) Pharmacognostical and preliminary phytochemical investigation of *lawsonia inermis* l. leaf, Rom J Biol, Plant Biol, 55(2):127-133.
- Jamshidi-Kia F, Lorigooini Z, Amini-Khoei H (2018) Medicinal plants: past history and future perspective. J Herbmed Pharmacol 7(1):1-7. doi: 10.15171/jhp.2018.01
- Karpe ST, Kulkarni SR, Shaikh SA, Manikrao AM (2011) Bacterioidal and bacteriostatic activity of isolated naphoquinone fraction of *Lawsonia inermis* and synthetic Lawsonone on *Staphylococcus epidermis*. Pharmacologyonline 2: 156 -163.
- Kırmızıgül AH, Gökçe E, Şahin M, Büyük F, İrmak K (2008a) Dermatofitozisli sığırlarda Enilconazole'ün (%10'luk Pour On) etkinliği. Kafkas Üniv Vet Fak Derg, 14:141-144.
- Kırmızıgül AH, Gökçe E, Özyıldız Z (2009a) Sığırlarda dermatofitozis tedavisinde enilconazole'ün (%10) topikal kullanımı: klinik, mikolojik ve histopatolojik bulgular. Kafkas Üniv Vet Fak Derg 15(2): 273-277. DOI:10.9775/kvfd.2009.001-A
- Kırmızıgül AH, Gökçe E, Büyük F, Erkilic EE, Çelebi Ö, Gülmez A, Çitil M (2013c) Effectiveness of the local application of 1% tioconazole in the treatment of bovine dermatophytosis. Kafkas Üniv Vet Fac Journal 19 (Suppl-A):A19-194. DOI:10.9775/kvfd.2013.8776
- Lewin R (2000) Modern İnsanın Kökeni, TÜBİTAK Popüler Bilim Kitapları, Çeviri: N. Özüaydın, 7. basım, TÜBİTAK, Ankara.
- Maarten JM, Christenhusz & James W. Byng (2016) The number of known plants species in the world and its annual increase. ISSN 1179-3163 (online edition) <http://dx.doi.org/10.11646/phytotaxa.261.3.1201> (accessed 13 February 2018)
- Makhija IK (2011) *Lawsonia inermis* from traditional use to scientific assessment. African Journal of Pharmaceutical Sciences and Pharmacy 2(1):145-165.
- Muhammad H, Muhammad S (2005) The use of *Lawsonia inermis* linn. (henna) in the management of burn wound infections African Journal of Biotechnology 4 (9): 934-937.
- Or E, Bakirel U (2002) Gevis getiren hayvanların iç hastalıkları. Ed. Y. Gül, Özkan Matbaacılık Ltd Sti, Ankara, pp 385-386.
- Habbal O, Hasson SS, El-Hag AH, Al-Mahrooqi Z, Al-Hashmi N, Al-Bimani Z, MS Al-Balushi, Al-Jabri AA (2011) Antibacterial activity of *Lawsonia inermis* Linn (Henna) against *Pseudomonas aeruginosa*. Asian Pac J Trop Biomed 1(3): 173-176. doi:10.1016/S2221-1691(11)60021-X
- Polat E (2014) Kronik enfekte yaralı bir köpekte kına (*lawsonia inermis*) bitkisinin tedavi amaçlı kullanılması. Harran Üniv Vet Fak Derg 3(2): 93-97.
- Ponugoti M, (2018) A pharmacological and toxicological review of *Lawsonia inermis*. International Journal of Pharmaceutical Sciences and Research (IJPSR) 9(3): 902-915. E-ISSN: 0975-8232; P-ISSN: 2320-5148.
- Rahmoun N, Otmani Z.B., Boucherit K., Benabdallah M. and Choukchou-Braham N (2013) Antifungal activity of the Algerian *Lawsonia inermis* (henna) Pharmaceutical Biology 51(1): 131-135. Informa Healthcare USA, Inc. ISSN 1388-0209 print/ISSN 1744-5116 online DOI: 10.3109/13880209.2012.715166
- Rayavarapu KA, Kaladhar DS, Kumar S (2011) Evaluation of antimicrobial activity of *Lawsonia inermis* (Henna) on aquapathogens. Journal of Pharmaceutical and Biomedical Sciences 7(02):1-3.
- Saadabi Abdulmoneim MA (2007) Evaluation of *Lawsonia inermis* Linn. (Sudanese Henna) Leaf Extracts as an Antimicrobial Agent. Research Journal of Biological Sciences 2: 419-423. URL: <http://medwelljournals.com/abstract/?doi=rjbsci.2007.419.423> (accessed 13 February 2018)
- Santosh Y, Kumar A, Dora J, Kumar A (2013) Essential Perspectives of *Lawsonia inermis*. International Journal Of Pharmaceutical And Chemical Sciences Vol. 2 (2) Apr-Jun 2013. Issn: 2277-5005. www.ijpcsonline.com
- Solecti R (1975) IV. a Neanderthal flower burial in Northern Iraq. Science. 190(4217): 880-81. doi:10.1126/science.190.4217.880.
- Şennazlı G (2018) Deri hastalıkları patolojisi ek ders notları. <http://cdn.istanbul.edu.tr/FileHandler2.ashx?f=deri-hastaliklari-patolojisi.pdf> (accessed 10 February 2018)
- Teklehaymanot T, Giday M (2007) Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. Journal of Ethnobiology and Ethnomedicine 3: 12. <https://doi.org/10.1186/1746-4269-3-12>
- Trease GE, Evans WC (1983) Pharmacognosy, Bailliere Tindall pp 241-244.
- Vaidya A (2000) Indian medicinal plant, Orient Longman: pp 303-307.
- Wabacha JK, Gitau GK, Bebor LC (1998) Occurrence of dermatomycosis (ringworm) due to *Trichophyton verrucosum* in dairy calves and its spread to animal attendants. Journal of the South African Veterinary

- ajcem.20140203.13
- Wallis TE (2001) Text book of pharmacognosy, CBS Publisher and Distributors: pp 578-614.
- Weber A (2000) *Mycozoonoses* with special regard to ringworm of cattle. *Mycoses* 43: 20-22.
- Yadav S, Kumar A, Dora J, Kumar A (2013) Essential Perspectives of *Lawsonia inermis* International Journal Of Pharmaceutical And Chemical Sciences 2 (2): 888-896.
- Yılmazer RE, Aslan Ö (2010) Sığırlarda mantar hastalığının sağaltımında nequvon ve whitfield's merheminin birlikte kullanımının etkinliğinin araştırılması, Sağlık Bilimleri Dergisi (Journal Of Health Sciences) 19(3):175-183.