

Kufa Journal for Veterinary Medical Sciences

vetmed@uoKufa.edu. iq

Employment of combined-extraction from Argan oil and diluted apple cider vinegar (ACV-AO) for refuting pediculosis in cats

Ph.D. Abdul-samad Uleiwi Hassan⁽¹⁾

MSc. Fawziyya Fakhry Al-Fayyadh⁽²⁾

Ph.D. Yarob Sa'ad Abdul-Jaleel⁽³⁾

1- Muthannah University, Dentistry college. samadovaabditch@gmail.com,

2- Kufa technical medical institution, f.ffh18@yahoo.com

3- Kufa University, Pharmacy college. yaaerbs.abduljaleel@uokufa.edu.iq

Abstract:

The present study demonstrated a positive effect of both argan oil & apple cider vinegar mixed with pure water RO in the healing of head lice disease, as it was the best concentration plant is 50% and the level of significance $p > 0.05$ after adding Argan oil by 1/200. Experience also showed not affected the cuticle transactions applicable to this mixture and instead it found that the direct impact of this solution is focused on the respiratory system of the lice to lead to a suffocating with stiff competent tissue and without any side effects mentioned during host's treatment.

استخدام مستخلص مركب من زيت الأركان مع مخفف خل عصير التفاح (ACV-AO) في دحض داء القمل في القطط

م.د. يعرب سعد عبدالجليل
جامعة الكوفة/كلية الصيدلة

م. فوزية فخري الفياض
المعهد التقني الطبي/الكوفة

ا.م.د. عبدالصمد عليوي حسن
جامعة المثنى/كلية طب الاسنان

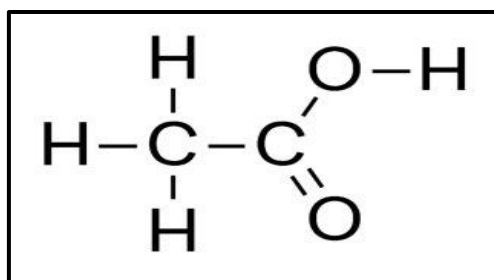
الخلاصة:

أثبتت الدراسة الحالية تأثيراً موجباً لخليط زيت الأركان مع مخفف خل عصير التفاح مع الماء النقي RO في الشفاء من داء قمل الفرو، إذ كان أفضل تركيز مصنع هو 50% وبمستوى معنوية $p > 0.05$ بعد أن أضيف له الزيت بواقع 200/1. كما أوضحت التجربة عدم تأثير الكيوتكل بالمعاملات المطبقة لهذا الخليط وبدلاً عنه وجد أن التأثير المباشر لهذا المحلول إنصب على الجهاز التنفسي للقمل ليؤدي إلى إختناقها مع تبيس للأنسجة المختصة وبدون أي آثار جانبية تذكر على المضائف المعالجة.

Introduction:

Apple cider vinegar (ACV) considered as a pale amber color vinegar made up from apple must and used as spices or preservatives^(1,2). ACV chemically defined as a diluted aqueous solution of ethanoic acid $HC_2H_3O_2$ ⁽³⁾ that is created biochemically through alcoholic

fermentation and acid fermentation by the role of acetobacter⁽⁴⁾. Physically, ACV characterized with a $pH=2.4$ that's earned it sour taste, it's density equal to 1.01 gm/ml, while it's melting and freezing points measured to be 213 °F and 28 °F respectively⁽⁵⁾.



Shape (1): structure of ethanoic acid used in our experiment

A lot of literatures^(6,7,8,9) mentioned that ACV chemical composition composed of calcium, iron, magnesium, phosphor, potassium, sodium and zink. In addition, ACV freed from proteins, lipids and fibers⁽¹⁰⁾. Beside that a low percentage 1% of carbohydrates and sugars as well as ethanoic acid rated 5%^(11,12).

Ancient and old civilizations counted vinegar as a natural grants and gifts because ease of preparation through exposure the apple juice in the air to invert into fermented vinegar to use as flavors and energy drinks; this is recorded about 5000 years BC by the Babylons and later in 3000 years BC by the Egyptians, then made by chinese in 1200 years BC then followed by the conclusion of Hippocrates in 400 years AC in greek where it is used as a medication⁽¹³⁾. Later, vinegars used in many purposes like the military field, food reach, preservative domain and medical range⁽¹⁴⁾.

Medically, ACV was widely popular in twentieth century according to its role in curing a lot of diseases around the world, e.g., cleaning mouth & pharynx, neutralizing stomach acidity, stretching muscles, treatment the intestinal indigestion, stopping hiccups, cleansing dandruff, relieving larynx pains, the freshness of the skin, therapy for acne and itching, and fitness programs based on decreasing

glucose and cholesterol rates. All of these medical prescriptions based on minute household and popular experiments acquired throughout past covenants and times to which laboratory and technical touch was needed desperately^(15,16).

Concerningly Argan oil was extracted from kernels of a rare organ tree that is endemic to the Sous valley of Morocco, where was it lived for about 200 years⁽¹⁷⁾. This oil used traditionally in cooking, as cosmetic and therapeutic purposes because it is composed of several essential fatty acids classified as omega 6&9 that are 42.8% oleic acid, 36.8% linoleic acid, 12% palmitic acid, 6% stearic acid and 0.5% linolenic acid; additionally it contains tocopherol, squalene, carotenes and natural phenols⁽¹⁸⁾. All of these qualifications enable berberian women to using it as cosmetics oil advocated for moisturizing and fortify skin, against acne and flaking, nourishing and brilliantine the hair, healing of burns, and the treatment of scaly or wrinkled dry skin^(17,18).

Head lice infestation one of the common diseases that infect both human and animals as well as⁽¹⁹⁾. This infestation caused by small arthropod animal belonging to suborder Anoplura (so called Siphunculata) that is included within order of Phthiraptera that was characterized with entirely wingless and small dorso-ventrally

flattened body; Their [thoracic](#) segments were fused, while [abdomen](#) being composed of seven visible [segments](#); Head have one pair of five segmented [antennae](#), head also have one pair of [eyes](#); Six short [legs](#) project from the fused segments of the [thorax](#), each one terminate with a [claw](#) and opposing "[thumb](#)"; there are seven visible segments of the [abdomen](#) where the first six segments each have a pair of [spiracles](#) used for breathing while the last one have the [anus](#) and the [genitalia](#)^(20,21,22).

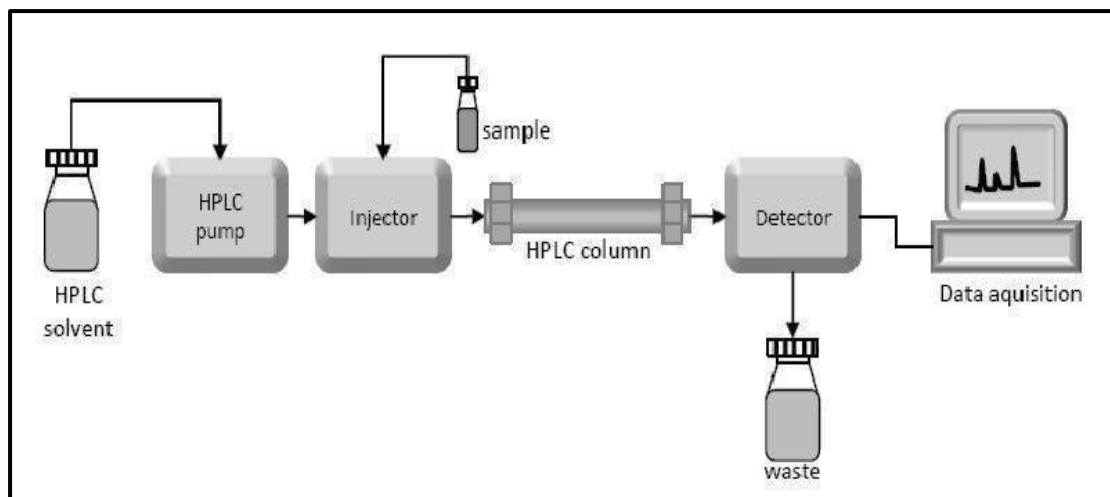
Fur lice females lay 3–4 eggs daily in a location that will be appropriate to proper embryo growth, where [they](#) are attached near the base of a host hair shaft. These adults females secretes later a glue from her reproductive organ to assist in formation "nit sheath" that covering hair shaft and nearly all the eggs except the operculum. Each egg is oval-shaped and about 0.68 mm in length, dark-colored so long as they contain an embryo, but appear clear after hatching after six to nine days after [oviposition](#). After hatching, the [nymphs](#) still attached to the hair shaft^(23,24,25).

Several of the infectious diseases transmitted with louse are life-threatening, including relapsing fever, epidemic typhus and trench fever, which are caused by *Borrelia recurrentis*, *Rickettsia prowazekii*, and *Bartonella quintana*, respectively. These diseases were remaining a major public health concern in populations living in poor-hygiene conditions because of social disruption, war, gaps in public health management, or severe poverty^(26,27,28).

Our study basic thought aimed to use domestic apple vinegar liquid with a selective concentration after mixing it with argan oil to refuting fur lice in cats, according to the regular scientific manner in a way to applicate this extraction on head lice in human by the future thoroughly by taking in part the common descent between lices of cat and human more than others.

Materials & Method:

A. Making the vinegar: domestic apple (*Malus domestica*) brought to the laboratory, it was squeezed to get the juice, where yeast was added to form ACV which by turn exposed to air after adding mother of vinegar. Later, the liquid left in 77 °F for 4 months and exhaustion for 2 years. Then vinegar sent to chemical analysis laboratory to detect it's components and features by high performance liquid chromatography () where its principle based on uncoupling technique that demand: the injection of a little volume of liquid sample into a tube packed with tiny particles (3 to 5 micron (µm) in diameter called the stationary phase) where single components of the sample are passed down the packed tube (column) with a liquid (mobile phase) powered through the column by high pressure conveyed by a pump. These components are dispartate from one another by the column filling that include various chemical/physical interactions between their molecules and the filling particles. Then these dispartate components are observed at the exit of this tube (column) by a flow-through device (detector) that calculate their amount. An output from this detector is called a "liquid chromatogram"⁽²⁹⁾.



Shape (2): principle of HPLC⁽²⁹⁾

B. Dilution of the vinegar: beside concentrated solution several descending dilution as a mixture expressed by percentage (%). Dilution ranked respectively: 75% of vinegar to 25% of water, 50% of vinegar to 50% of water, and 25% of vinegar to 75% of water.

C. Extraction Argan oil: we dried argan fruit in the air and then remove the pulp. Next stage involved cracking the Argan nut to get the kernels, where they roasted with hot metal plate before cooling. Later the kernels ground and pressed till it gives oil, which kept in a sterilized glass flask for 2 weeks before filtration supernatant in order to use it directly in our tests.

D. Treating the lice: cat louse (*Felicola subrostratus*) treated by applying three routes according to the suggested scientific hypothesis and the commitment of professional behavior as well as laws correlated with respectation of animal rights.

D-1. Treating isolated lice: a 2000 insect collected from the fur of models where they divided into 4

groups, each one put in sterilized glass small petri dishes in a way to treating them with different dilution parameters of ACV after 10 minutes of collection.

D-2. Treating infested cat: a 100 domestic cat (*Felis catus*) infected with pediculosis divided into 4 groups equally and quarantined in designing rooms for this in a veterinary hospital. Later, each group exposed into one of the graduated concentrations of water and vinegar. Results recorded depending on number of lice killed and the time spends for this action take in part the presence or absence of side effects during tests.

E. Statistical analysis: all the data and results scheduled and tabulated by the statistical computerized analysis (SPSS) basing on the correlated references to get minute feedback⁽³⁰⁾.

Results:

A. According to the chemical analyses, observations turns out that manufactured ACV composed of the following features and substances which are listed down in table no. 1.

Table no.1: several physical and chemical properties of ACV prepared and tested in our research.

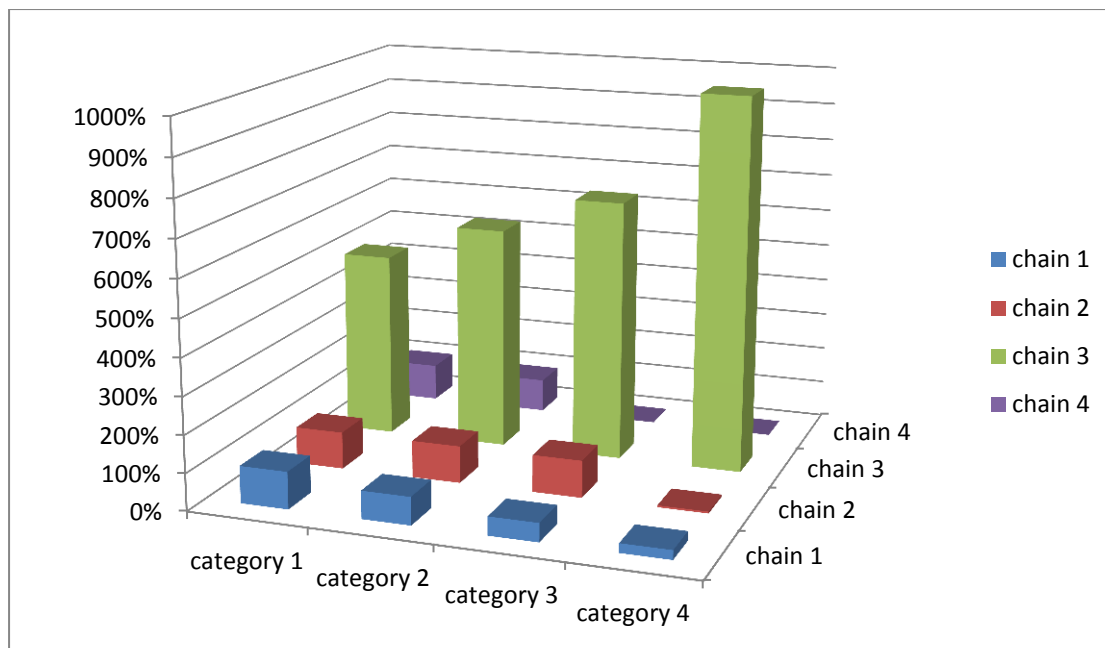
Character or	Unit	Evaluation or percentage
Odor	-	Pungent
Taste	-	Sour
Calcium	100 mg/ml	6.5
Iron	100 mg/ml	0.28
Magnesium	100 mg/ml	5.1
Phosphorus	100 mg/ml	7.8
Potassium	100 mg/ml	80
Sodium	100 mg/ml	5.4
Zinc	100 mg/ml	0.035
pH	-	2.4
Acetic acid	%	5
Specific gravity	gm/ml	1.019
Freezing point	° F	27
Boiling point	° F	209
Chemical formula	-	C ₂ H ₄ O ₂

B. The best effective therapeutic dilution of ACV exemplified with the medium one 50:50 (table-2 & scheme-1), due to its obvious role in eradication lice infestation without any side effects by the assistance of argan oil 1 ml. Its deserve mention that most obvious side effects when used high concentrations of ACV are allergic reactions, tearing and cracking of the head scalp, weakness in growth and brittleness of the hair.

Table no.2: therapeutic levels and effectiveness of combined extraction supposed in our experiment on lice infestation.

Level	Dilution/percentage	Refuting percentage	Treatment period	Side effects
1	100% ACV/1 ml oil	100%	1×5 daily	Present and severe
2	75% ACV/1 ml oil	100%	1×6 daily	Present and obvious
3	50% ACV/1 ml oil	100%	1×7 daily	Not present *
4	25% ACV/1 ml oil	5%	1×10 daily	Ineffective

* in statistics mean a significant difference on 0.001 levels within one line.



Scheme no.1: therapeutic levels and effectiveness of the combined extract of ACV and Argan oil on lice infestation take in part the side effects appearance and daily doses.

C. Microscopic and histological investigations on the lice explains that these insects killed through suffocation through inhalation of the strong and scented aroma for this extract. Images 1 & 2 in below explains those insects tends to appear stuffed without any signs of tearing and wore off, except few superficiality cracks in some parts of the louse body.

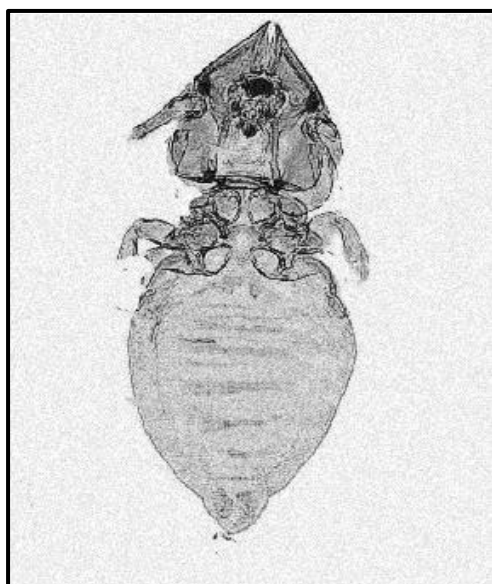


Image no. 1: a dead lice after treated with ACV-AO mixture. Look signs of wear off, cut off and tearing with signs of suffocation, 50 X.

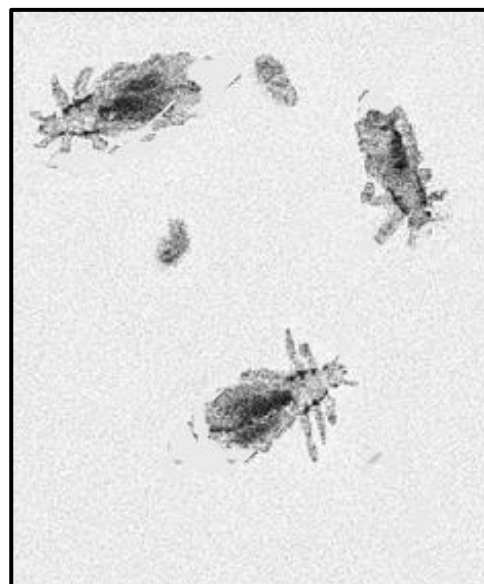


Image no. 2: lice, nymphs and eggs of *Felicola subrostratus* captured after treated with ACV-AO 50:50 dilution, 25X.

Discussion:

After reviewing the results it seems that fur lice treated with combined extraction ACV-AO was killed by suffocation according to a conclusion that conjugated with a scientific evidences which applied in this research. So, the best evidence of this result is the isolated cuticle treated with ACV-AO extraction had not affection, this is confirmed by the studies of Mowatt⁽³¹⁾ and both of Fernandez & Ingbar⁽³²⁾ on shrilk which is an artificial cuticle composed from fibroin and chitosan proteins that is characterized by its elasticity and flexibility when it was exposed to a strong acids^(33,34,35). Accordingly, we suggested that ACV never affect lice insects directly through punctuation their exoskeleton and endocuticle, but instead it effect done through another way in demand to investigate it and draw attention!

The subject of controversy here centered about the causes of cracks, wear off, tearing and cutouts for several parts of lice treated with ACV-AO!. We found the causes of these destructions in their bodies hold off by mechanical and physical reasons, not as it is interpreted as a chemical cause. Justification this explanation supported by the founding these dead lice which treated previously with ACV-AO not showed any signs of breakdowns or losing any of their parts while pick up by hands later, not that use lice comb for the fur and hair leads to many cases of this type of cracks, wear off, tearing and cutouts^(36,37,38).

With regard to therapeutic action of ACV-AO we found through microscopic examination that lice insects get died suffocated because there isn't accompanied available physical evidence about cutouts or wore off for any part of their body after treating ACV-AO, paving the way to

consider this therapy done its role by its pungent odor (chemical investigations, table-1) which have been sensed and identified by the trigeminal nerve^(39,40). Odor of ACV resulting from occurrence of carboxylic acid in the composition of this vinegar, included within ethanoic acid structure (C_2H_5COOH), where this strong and stingy odor arose to actively assist in suffocation physiology of lice through irritation of the tissues neighbours to the contracted spiracles causing difficulty in respiration process accompanied with cases of extrusion and topical burns in these regions due to direct chemical reaction between ethanoic acid and those tissues which is led to signs of burns, inflammatory-allergic reactions due to partial lysis of these tissues in what it called chemical burn which is defined as broken down the bonds of the basic building units for the insect's tissues leading to erosion, expulsion, filtration, tearing, destroying and finally destruction of the tissue according to corrosion action that is in turn based on acid-base principle that's ends with amide or ester hydrolysis by which chemical bonds destroyed, causing chemical burns^(41,42,43,44).

Depending on the results of testing the best dilution of ACV-AO used, which conducting in our research, data showed that 50:50 was that one in its action and effectivity. The explanation for this based on several factors; first matter is that adding of more water will help in diluting the acidity of ethanoic acid by half in ACV without losing its effectivity as a therapy, by the way, it assists in buffering many bacterial inflammations and microbial violence spreading on treating tissues, beside that the role of water in washing the regions where vinegar concentrated after treatment⁽⁴⁵⁾. Second one is that diluted ethanoic acid act as disinfectant

effectively more than concentrated case, as it was proposed by previous studies and researches on the role of diluted ethanoic acid in the treatment of nephritis and cleansing the uterus^(46,47,48). Third factor is the disappearing of the side effects after using this dilution was proven occurrence a state of chemical equilibrium in the mixture's composition in a way led to the healing of this infestation without side effects, taking in part this type of equilibrium was controlled by acid-base balance laws that is dependent confidentially to adjusting parameters of equilibrium and pharmaceutical productions⁽⁴⁹⁾.

Adding of Argan oil to the extraction of ACV in our study based on its chemical structure that is abundant with high amounts of both vitamin E-gamma and five types of essential fatty acids especially oleic and linoleic acids with a percentage 80%. Tocopherol assists within ACV-AO mixture as an antioxidant and a remover of free radicals and so it helps in protection of fibroblasts and hair bases within the skin beside its role in conserving the linkage cast of water particles enter in composition of both skin and hair and depending on kept its moisture to prevent their drying and cutouts. On the other hand, essential fatty acids participate in the maintaining cell's plasma membranes of hair and skin in addition to their role in anabolism and metabolism of prostaglandins which considered as anti-inflammatory and healer biological substances⁽⁵¹⁾.

A conclusion that is achieved from our research explain the obvious efficiency of use ACV-AO mixture in curing lice infestation in cats, this was pave the way to do many subsequent and deep studies on the biological, pharmaceutical and technology levels to prove that using this mixture will be confirming its successful, efficaciously

and constructively without side effects recorded especially when applied on lice infestations cases of human.

References:

- 1- عمر، احمد مختار (2008). معجم اللغة العربية المعاصرة. عالم الكتب - القاهرة. ص: 690.
- 2- مجمع اللغة العربية (2004). المعجم الوسيط. مكتبة الشروق الدولية- القاهرة. ص: 253.
- 3- Nakayama, T. (1959). Studies on acetic acid-bacteria I. Biochemical studies on ethanol oxidation. The journal of biochemistry: Vol.: 46, No.: 9, P: 1217-1225.
- 4- Tan, S. C. (2005). VINEGAR FERMENTATION. A master thesis. Louisiana State University. Agricultural and Mechanical College.
- 5- Piyasena, P., M. Rayner, F.M. Bartlett, X. Lu, and R.C. McKellar (2002). Characterization of Apples and Apple Cider Produced by a Guelph Area Orchard. LWT - Food Science and Technology. Volume 35, Issue 7, Pages: 622-627.
- 6- Budak N. H., Kumbul D. D., Savas C. M., Seydim A. C., Kok T. T., Ciris M. I. and Guzel-Seydim Z. B. (2011). Effects of apple cider vinegars produced with different techniques on blood lipids in high-cholesterol-fed rats. J Agric Food Chem. ;59(12):6638-44.
- 7- Renard, C.M.G.C., Le Quéré, J.M, Bauduin, R., Symoneaux, R., Le Bourvellec, C., Baron, A. (2010). Modulating polyphenolic composition and organoleptic properties of apple juices by manipulating the pressing conditions. Food Chemistry, 124:117-125.
- 8- Picinelli, A., Suárez, B., Moreno, J., Rodríguez, R., Caso-García, L.M., Mangas, J.J. (2000). Chemical characterization of Asturian cider. Journal of Agricultural and Food Chemistry, 48:3997-4002.
- 9- Dabija, A., C. A. Hatnean (2014). Study concerning the quality of

- apple vinegar obtained through classical method. *Journal of Agroalimentary Processes and Technologies*, 20(4), 304-310.
- 10-Bragg, P., P. C. Bragg (2008). *Apple Cider Vinegar: Miracle Health System*. (56 th edn.). Bragg Health Sciences, USA. ISBN: -978 0877901006.
- 11-Holzappel, C. (2002). *Apple Cider Vinegar: For Weight Loss and Good Health*. (3-rd edn.). Book Publishing Company, UK. ISBN: 9781570671272.
- 12-Wilson, S. M., Le Maguer, M., Duitschaever, C., Buteau, C. and Allen, O. B. (2003). Effect of processing treatments on the characteristics of juices and still ciders from Ontario-grown apples. *Journal of the Science of Food and Agriculture*, 83: 215–224.
- 13- Rose, V. (2006). *Apple Cider Vinegar: History and Folklore—Composition—Medical Research—Medicinal, Cosmetic, and Household Uses—Commercial and Home Production*. (1-st edn.). iUniverse, Inc., USA. ISBN: 978-0595412372.
- 14- Orey, C. (2000). *The Healing Powers of Vinegar: A Complete Guide to Nature's Most Remarkable Remedy*. (1-st edn.). Kensington, USA. ISBN:9781575666099.
- 15- Mindell, E. (2002). *Dr. Earl Mindell's Amazing Apple Cider Vinegar*. (1-st edn.). McGraw Hill Professional, USA. ISBN: 9780071821216.
- 16- Östman, E., Granfeldt, Y., Persson, L., Björk, I. (2005). Vinegar supplementation lowers glucose and insulin responses and increases satiety after a bread meal in healthy subjects. *European Journal of Clinical Nutrition*, 59:983–988.
- 17- Khallouki, F; Younos, C; Soulimani, R; Oster, T; Charrouf, Z; Spiegelhalder, B; Bartsch, H; Owen, RW (2003). ["Consumption of argan oil \(Morocco\) with its unique profile of fatty acids, tocopherols, squalene, sterols and phenolic compounds should confer valuable cancer chemopreventive effects"](#). *European Journal of Cancer Prevention*. **12** (1): 67–75.
- 18- Charrouf, Z. and Guillaume, D. (2008). "Argan oil: Occurrence, composition and impact on human health". *European Journal of Lipid Science and Technology*. **110** (7): 632.
- 19- Koch T., Brown M., Selim P., and Isam C. (2001). Towards the eradication of head lice: literature review and research agenda. *J Clin Nurs.*;10(3):364-71.
- 20- Maunder, J. W. (1983). "The Appreciation of Lice". *Proceedings of the Royal Institution of Great Britain (London)* 55: 1–31.
- 21- Kittler R., Kayser M, Stoneking M (August 2003). "Molecular evolution of *Pediculus humanus* and the origin of clothing". *Current Biology* 13 (16): 1414–7.
- 22- Buxton, Patrick A. (1947). "The Anatomy of *Pediculus humanus*". *The Louse; an account of the lice which infest man, their medical importance and control* (2nd ed.). London: Edward Arnold. pp. 5–23.
- 23- Salant, H., Mumcuoglu, K. Y. and Baneth, G. (2014). Ectoparasites in urban stray cats in Jerusalem, Israel: differences in infestation patterns of fleas, ticks and permanent ectoparasites. *Medical and Veterinary Entomology*; 28(3): 314–318.
- 24- Aguiar, J., Machado, M. L., Ferreira, R. R., Ramos, R. Z., Hunning's P. S. and Muschner, A. C. (2009). Mixed infestation by *Lynxacarus radovskyi* and *Felicola subrostratus* in a cat in Porto Alegre, RS, Brazil. *Acta Scientiae Veterinari*; 37(3): 301-305.
- 25- Starkey, L. A. and Stewart, J. (2015). Recommendations from the companion animal parasite council:

- Feline Arthropods. *Today Vet Pract.* 59-63.
- 26- Busvine, J. (2012). Disease Transmission by Insects: Its Discovery and 90 Years of Effort to Prevent it. (1-st edn.). Springer Science & Business Media, USA. ISBN:9783642457166.
- 27- Service, M. (2012). Medical Entomology for Students. (5-th edn.). Cambridge University Press; UK. ISBN:9781107380226.
- 28- Goddard, J. (2009). Infectious Diseases and Arthropods. (1-st edn.). Springer Science & Business Media, USA. ISBN: 9781603274005.
- 29- Gerber, F.; Krummen, M.; Potgeter, H.; Roth, A.; Siffrin, C.; Spöndlin, C. (2004). "Practical aspects of fast reversed-phase high-performance liquid chromatography using 3µm particle packed columns and monolithic columns in pharmaceutical development and production working under current good manufacturing practice". *Journal of Chromatography A*. **1036** (2): 127–133.
- 30- Box, G. E.; Hunter, W. G.; Hunter, J. S. (2005). Statistics for Experimenters: Design, Innovation, and Discovery (2nd ed.). Wiley. ISBN 0-471-71813-0.
- 31- Mowatt, Twig (2012) Inspired by Insect Cuticle, Wyss Researchers Develop Low-Cost Material with Exceptional Strength and Toughness. Wyss Institute, Harvard university.
- 32- Fernandez JG, Ingber DE. Unexpected Strength and Toughness in Chitosan-Fibroin Laminates Inspired by Insect Cuticle. *Advanced Materials [Internet]*. 2012;24 :480-484.
- 33- Rebers JE , Willis JH (2001). A conserved domain in arthropod cuticular proteins binds chitin. *Insect Biochemistry and Molecular Biology*. 31(11):1083-1093.
- 34-James L. Nation, Sr. (2015). *Insect Physiology and Biochemistry*. (3 rd edn). CRC Press, USA. ISBN: 9781482247602.
- 35- Sharma, A. K. (2012). *Anatomy and Physiology of Insects*. (1st edn). Jaipur Publishing House, India. ISBN: 9789350300435.
- 36- Acton, Q. Ashton (2012). *Parasitic Skin Diseases—Advances in Research and Treatment*. (1 st edn). Scholarly Editions, USA. ISBN: 9781481610612.
- 37- Winston, Judith (2012). *Describing Species: Practical Taxonomic Procedure for Biologists*. (1 st edn). Columbia University Press, USA. ISBN: 9780231506656.
- 38- Schmidt, Diane (2014). *Using the Biological Literature: A Practical Guide*. (4 th edn). CRC Press, USA. ISBN: 9781466558571.
- 39- Feroz, Muhammad Zain, Ali Feroz Khan, Muhammad Awais Ashraf, Muhammad Umer Qadeer, Hafiz Muhammad Adnan (2015). Production of ethanoic acid by oxidation of ethanol. *International Journal of Chemical Studies*; 4(1): 46-47.
- 40- Dabija, A. and C. A. Hatnean (2014). Study concerning the quality of apple vinegar obtained through classical method. *Journal of Agroalimentary Processes and Technologies* 2014, 20(4), 304-310.
- 41- Chibishev A., Simonovska N. and Shikole A. (2010). Post-corrosive injuries of upper gastrointestinal tract. *Contributions, Sec. Biol. Med. Sci., MASA*, XXXI, 1, p. 297–316.
- 42- Chibishev, A., A. Sikole, Z. Pereska, V. Chibisheva, N. Simonovska, and N. Orovchanec (2013). Severe renal function impairment in adult patients acutely poisoned with concentrated acetic acid. *Arh Hig Rada Toksikol*;64:153-158.
- 43- Thomann, W. R. (2003). Chemical Safety in Animal Care, Use, and Research. *ILAR J* (2003) 44 (1): 13-19.
- 44-De Frémicourt, M.K., R. Lavocat , M. Chaouat , D. Boccara, O. Marco

- and M. Mimoun (2015). How to treat a vaginal burn due to acetic acid?. *European Journal of Plastic Surgery*, Volume 38, Issue 4, pp 335–338.
- 45- Duraipandiyar, V., M. Ayyanar and S. Ignacimuthu (2006). Antimicrobial activity of some ethnomedicinal plants used by Paliyar tribe from Tamil Nadu, India. *BMC Complementary and Alternative Medicine*, Vol: 6; 35.
- 46- Johnston, C. S. and Cindy A. Gaas (2006). Vinegar: Medicinal Uses and Antiglycemic Effect. *MedGenMed*. 2006; 8(2): 61.
- 47- Cortesia, C., C. Vilchèze, A. Bernut, W. Contreras, K. Gómez, J. de Waard, W. R. Jacobs Jr., L. Kremerc and H. Takiff (2014). Acetic Acid, the Active Component of Vinegar, Is an Effective Tuberculocidal Disinfectant. *mBio* vol. 5, no. 2 e00013-14.
- 48- Alomar, M. J. (2014). Factors affecting the development of adverse drug reactions (Review article). *Saudi Pharmaceutical Journal*, Volume 22, Issue 2, Pages 83–94.
- 49- Kass-Bartelmes, Barbara L. and Lynn Bosco (2014). Reducing Costs and Improving Outcomes. Agency for Healthcare Research and Quality, *Research in Action*, Issue 8. Publication # 02-0045.
- 50- Monfalouti, H. E., Guillaume, D., Denhez, C. and Charrouf, Z. (2010). "Therapeutic potential of argan oil: a review". *J Pharm Pharmacol*. **62** (12): 1669–75.
- 51- El Babili, F., Bouajila, J., Fouraste, I., Valentin, A., Mauret, S. and Moulis, C. (2010). "Chemical study, antimalarial and antioxidant activities, and cytotoxicity to human breast cancer cells (MCF7) of *Argania spinosa*". *Phytomedicine*. **17** (2): 157–60.

