

EFFICACY OF VIRGIN COCONUT (*Cocos nucifera*) OIL SOAP AGAINST MANGE IN DOGS

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ABSTRACT

This study was conducted to a) determine the efficacy of VCO soap against mange in dogs; b) determine the most effective concentration of VCO soap against mange in dogs; and c) identify the species of mites affected by VCO soap.

Fifteen mongrel dogs positive of mange regardless of sex and age were used in the study. They were distributed into five treatments and replicated thrice with one dog per replicate using the Complete Randomized Design (CRD). Before the application, skin scrapings were taken from three different sites on the animals to identify the species of mites present and determine their number. The experimental dogs were bathed twice a week for eight weeks using the different preparations such as the following:

- T₀- - 60% Oil/100 g soap
- T₀+ - 1 ml Amitraz
- T₁ – 50% VCO/100 g soap
- T₂ – 60% VCO/100 g soap
- T₃ – 70% VCO/100 g soap

The gathered data were tabulated using means and percentages. Analysis of Variance (ANOVA) was used to determine differences among the treatments. Every after two weeks of application of VCO soap, post-treatment mite count was done on each study dogs using the same site as the pre-treatment mite count. Results showed that VCO soap is highly effective against mange in dogs. Seventy percent (70%) is the most effective concentration of VCO soap against mange in dogs. There are two types of mites affecting dogs, *Sarcoptes* and *Demodex* species.

INTRODUCTION

Herbal medicine is probably the oldest and most popular form of health cure. It is said to be the foundation of all medicines and has been of service to mankind from

the ancient times to the present. Despite the fact that modern medicines are now increasing, and technology is becoming more highly powered and sophisticated, there is still a place for traditional remedies in the cure of diseases. Few reasons for these are that new drugs are too costly. They can give a variety of adverse reactions. Resistance to drugs can be acquired from improper dosing. When improperly used, it could put the human life at risk, and death could be the worst sequel if not given an immediate treatment. In addition to these, some commercially prepared medicines simply do not work effectively. On the other hand, herbal medicines are generally gentler, safer, and more effective than their conventional counterpart. With all these reasons it is no wonder now why there are people who still believe and practice the alternative medicine.

Herbal medicine in its sense is the use of plant's seed, berries, roots, leaves, bark and flowers. Herbal plants are fit for this medicinal purpose. In the Philippines, there are thousands of herbal plants that folklore has attributed medicinal benefits to. Studies in search for scientific validity involve only a handful of them. As of now, there are 360 species in the List of Philippine Herbal Medicinal Plants Site and coconut is one of them (<http://www.herbalmedicine.philsite.net>).

Coconut (*Cocosnucifera*) aside from its being medicinal plant was tagged as the "tree of life" because of the endless list of products and by-products we get from its various parts. Food, fuel, shelter, name it, the coconut has it! (<http://www.pca.da.gov.ph/tol.htm>)

Virgin coconut oil (VCO) is one of the products derived from the coconut meat. It is the natural oil obtained from fresh mature kernel of the coconut by mechanical extraction. Its main active constituent is the lauric acid, which is according to research studies can provide a wide range of health giving benefits summarized as antibacterial, antifungal, anti parasitic, anti protozoa, anticancer, antiviral, natural fat burner, energy booster, for cooking and dressing, dietary supplement, for hair and skin care and others.

Numerous reports have been cited that some of the above mentioned benefits of VCO are proven already to human. Tests on coconut oil's effect on dogs in clinical trials are not readily available, but anecdotal evidence is impressive. Reports published on Internet forums describe how overweight dogs become lean and energetic and a shabby-looking coat become sleek and glossy soon after eating coconut oil. Other reports involve itchy skin, cuts, wounds, and ear problems. Dogs with flea allergies typically stop scratching soon after coconut oil is added to their food. Another interesting report said that a pet owner tried using VCO to cure the bad breath, fleas and ticks and even mange of his dog. A couple of spoonful with each meal was introduced daily. The problems were gone in just few weeks of treatment (Puotinen, 2004).

Mange is one of the infectious diseases that can seriously affect the dog's health if untreated. It is caused by mange mites. Most people are familiar with mange because of its presence in their pets, often dogs and cats. There are a variety of mange mites, but only a handful of them affect pets.

Mange mites themselves cannot be seen with the naked eye, but the effects of their burrowing can be very dramatic. There are two most common mites that are isolated in dog; the *Sarcoptes* and *Demodex* species. Sarcoptic mange is an extremely itchy skin disease that is sometimes referred to as 'canine scabies'. This type of mange usually attacks areas without hair such as the abdomen and elbows. In demodectic mange, the mites in this type of mange actually live in the hair follicles and are very itchy. It can spread to the entire body and be difficult to cure, but early treatment is usually successful.

Many brands of acaricides are available in the market. They may be oral or injectable medications, topically applied formulations, dips and shampoos that can be employed in mangy dogs. In some instances, a combination of these may be needed one or more times daily for several days or weeks. However, due to the high cost of these commercial medications which is often the most common reason of pet owners, mangy dogs were left as it is. In order to help our pet dogs from their burdens, it is now the concern of this study to find for a cheap yet effective non-chemical treatment for mange. Hence, this study was conducted to evaluate the ectoparasiticide effect of the different concentrations of VCO incorporated in soap against mange of dogs.

Objectives of the study

The study had the following specific objectives:

- a) to determine the efficacy of VCO soap against mange in dogs;
- b) to determine the most effective concentration of VCO soap against mange in dogs; and
- c) to identify the species of mites affected by VCO soap.

REVIEW OF RELATED LITERATURE

The tree of life has undoubtedly invaded the medical community. From its long time tag as an export winner crop, coconut, particularly its oil, is now regarded by medical experts world wide as a powerful tool against infectious diseases.

Ticzon (1996) described the coconut (*Cocosnucifera*) as high unarmed, unbranched tree, reaching up to 25 meters high. The roots grow deep, and they are numerous. The leaves at the upper end of the tree form an apical crown, featherlike compound. The fruit is a three angled and one seeded, the fruit is surrounded with fibers and a hard shell with three apical eyes. The inside is a white edible flesh supplied with sweetish water.

The best coconut trees are those that grow from volcanic and nutrient rich soil. The Philippines is right in the middle of the volcanic center known as the "ring of fire", located 11° north of the equator. These are devoid of pesticides and with no hybrids (Mercola, 2006).

Garcia (2003) documented that Virgin Coconut Oil (VCO) is a naturally processed product from fresh coconut meat or its derivative (coconut milk and milk residue). It is the purest form of oil, is water white in color and has not undergone any chemical

processing during extraction. It contains natural vitamin E and very low free fatty acid with mild scent. It has been around for quite sometime but was not given much attention until some researchers found that it possesses the fatty acid known as lauric acid.

As cited by Brekel (2004), the fatty acids composition of VCO are the following: lauric acid-46%, myristic acid-19.9%, palmitic acid-9.8%, caprylic acid-6.8%, oleic acid-6%, capric acid-6%, stearic acid-3.4%, linoleic acid-1.3%, and caproic acid-4%. Among them the beneficial medium chain fatty acids are lauric, capric, caproic, caprylic and myristic acids.

Lauric acid or dodecanoic acid is an antimicrobial fatty acid with structural formula $\text{CH}_3(\text{CH}_2)_{10}\text{COOH}$. Caprylic acid ($\text{C}_8\text{H}_{16}\text{O}_2$) is an antifungal short chain fatty acid and has unpleasant smell and taste used in making dyes. Capric acid ($\text{C}_{10}\text{H}_{20}\text{O}_2$) is used in artificial flavors. Caproic acid ($\text{C}_6\text{H}_{12}\text{O}_2$) is a liquid fatty acid that occurs in fats and oils or is made synthetically used in flavorings and in medicine. Myristic acid ($\text{C}_{14}\text{H}_{28}\text{O}_2$) is an acid found in the fats of plants and animals, and used in making soaps, flavoring, cosmetics, and perfumes. Oleic acid ($\text{C}_{18}\text{H}_{34}\text{O}_2$) is an unsaturated fatty acid used to make soap, ointments, cosmetics and lubricating oils. Linoleic acid ($\text{C}_{18}\text{H}_{32}\text{O}_2$) is an essential fatty acid, colorless liquid, essential to human nutrition, found in linseed and other natural oils and used in making soaps, emulsifiers, and quick drying oils. Stearic acid ($\text{C}_{18}\text{H}_{36}\text{O}_2$) is a colorless, odorless waxy crystalline fatty acid used in cosmetics, soap and lubricating medicine.

Dayrit (2003) stressed that lauric acid, a major active component of the coconut oil, is a medium chain fatty acid which is converted into monolaurin when processed by the body. Monolaurin is used by human or animal to kill lipid coated viruses such as HIV, herpes, cytomegalovirus, influenza, and other pathogenic bacteria like *Listeria monocytogenes* infecting dairy cattle and poultry, and *Helicobacter pylori* that causes ulcer. Other health wonders coconut oil could do include reduction of cardiovascular diseases, fungal skin diseases, weight loss stimulating, and boost the immune system.

Kabara(2004) noted that lauric acid is most potent particularly in its monoglyceride form, monolaurin. It is postulated that monolaurin solubilizes or dissolves the lipids, causing the disintegration of the covering or envelope of the disease causing organism, with the cover torn down; the integrity of the pathogen is compromised resulting to death.

Dayrit (2003) and Fife (2001) complemented that Medium Chain Fatty Acids (MCFA) are easily digested and absorbed by the body. They are not packaged into lipoproteins and do not circulate in the bloodstream like other fats, instead they are sent directly to the liver where they are immediately converted into energy.

Coconut oil is known for its many uses such as massage oil and body lotion leaving the skin soft and smooth, relieving dry skin itchiness and other skin diseases, making the skin supple (Enig, 2003).

In the Philippines, coconut oil is much used as a vehicle for liniments in the skin medicines, external application for hair strengthening, made into cosmetics and remedy for alopecia. The lower and cheaper grades of the coconut oil which usually contain a

considerable portion of free fatty acids are used principally for making soap, lotion and hair beautifiers (Quisumbing, 1978).

When coconut oil which is made of triglycerides, is put on the skin, it doesn't any have immediate antimicrobial action. However, bacteria which are always present on the skin turn these triglycerides into free fatty acids, just as it does with sebum; the result is an increase in the number of antimicrobial fatty acids on the skin and protection from the infection.

According to Fife (2001), coconut oil is one of the most popular oils used in soap making. It has a nice fresh smell and yields a nice fluffy lather. It is a nice moisturizing soap that is a favorite among many.

When bathing or showering, soap washes the protective layer of oil and acid off the skin. Often afterwards the skin becomes tight and dry. Adding moisturizer helps the skin feel better, but it does not replace the acid or the protective MCFA layer that was removed and the skin is vulnerable to infection at this time. Many germs survive washing by hiding in cracks and folds of the skin. Before long the skin is again teaming up with microorganisms, both good and bad. Until sweat and oil return to establish the body's chemical barrier the skin is vulnerable to infection. By using coconut oil, it can quickly help reestablish the skin's natural antimicrobial and acid barrier.

Sodium hydroxide (NaOH) is white, odorless, and non-volatile solution. It was produced mainly in three forms: 50% and 73% aqueous solution and anhydrous sodium hydroxide in the form of solid cakes, flakes or beads. Its uses include: chemical manufacturing, pulp and paper manufacturing, petroleum and gas industry, manufacture of soap and detergents, and other cleaning products. NaOH is extremely corrosive and is capable of causing severe burns with deep ulceration and permanent scarring. It can penetrate to deeper layers of the skin and corrosion will continue until removed. The severity of injury depends on the concentration of the solution and the duration of exposure(http://www.msds.org/oshanswers/chemicals/chem_profiles/sodium_hydroxide/basic_sodium.html).

VCO is ideal for skin care. Peat (2006) considered coconut oil to be an antioxidant due to its stability and resistance to oxidation and free radical formation. Coconut oil that is incorporated in the diet reduces the need for Vitamin E.

Pure VCO is the best natural ingredient for skin lotion, cream, ointment and soap. It prevents destructive free radical formation and protection against them. It can help to keep the skin from developing liver spots, and other skin blemishes caused by aging and over exposure to sunlight. It helps to keep connective tissue strong and supple so that the skin doesn't sag and wrinkle. It might even restore damaged and diseased skin. The oil is absorbed into the skin and into the cell structure of the connective tissues, limiting the damage excessive sun exposure can cause.

Coconut oil will not only bring temporary relief to the skin, but it will aid in healing and repairing. It will aid in removing the outer layer of dead skin cells, making the skin smoother. The skin will become more evenly textured with a healthy shine.

Mercola (2006) concluded that the small molecular structure of the coconut oil allows it for easy absorption through the skin. The antiseptic fatty acids in the coconut

oil help to prevent fungal and bacterial infections in the skin when it is consumed and to some extent, when it is applied directly to the skin. The only way to gain entry into the body other than the nose and mouth is by penetrating the skin.

VCO when given to pet dogs can also have the same multiple benefits as in human, such as: reduces bad odor and bad breath, clears up eczema, flea allergies, contact dermatitis, itchy skin etc., improves digestion, may help with arthritis and ligament problems, and many more.

Mange is a skin disease found in many mammals and is caused by mite that burrows beneath the skin. Mite is any arthropod of the order Acarina characterized by minute size, usually transparent or semi-transparent body. They may be free living or parasitic on animal and may produce various irritations of the skin (Blood and Studdert, 1998).

Sarcoptes scabiei var canis, the itch mite which has been recorded to cause sarcoptic mange in pet dogs. The eggs are oval and the body of the mite is almost circular with short legs. The entire lifecycle is spent on the host and requires 17-21 days for completion. Eggs are laid in tunnels formed by the female burrowing in the skin (Fraser, 1991).

Wall and Shearer (2001) described that the adult of this species has a round, ventrally flattened and dorsally convex body. Adult females are 0.3-0.6 mm long and 0.25-0.4 mm wide, while males are smaller, typically up to 0.3 mm long and 0.1-0.2 mm wide. The posterior two pairs of limbs do not extend beyond the body margin. In both sexes, the pretarsi of the first two pairs of legs bear empodial claws and a sucker-like pulvillus borne on a long, stalk-like pretarsus. The sucker-like pulvilli help the mite grip the substrate as it moves. The third and fourth pairs of legs in the female and the third pair of legs in the male end in long setae and lack stalked pulvilli. The mouthparts have rounded appearance. These mites have no eyes or stigmata. The dorsal surface of the body is covered with transverse ridges but also bears a central patch on triangular scales. The dorsal setae are strong and spine-like. The anus is terminal and only slightly dorsal. The female mites are almost twice as large as males. The female burrows tunnels in the stratum corneum and lays her eggs. Sarcoptic mange is readily transmitted between dogs by direct contact. The incubation period is variable (10 days-8 weeks) and depends on the level of exposure, body site, and number of mites transmitted.

The preferred site of infestation depends on the host, with mites generally being more common on sparsely haired parts of the body such as the ears, face or muzzle in dog.

Sarcoptes scabiei mites do not bite or suck blood. They ingest the fluid between the skins. The irritation arises from their burrowing and feeding activity and irritation caused by the secretory and excretory products produced by the female. Initially the pruritus is mild and lesions are merely erythematous. As the irritation progresses they become papular and rupture, leading to hair loss and the formation of yellow crust of dried exudates. The cutaneous response reflects inflammation produced by keratinocyte damage and the development of cutaneous hypersensitivity (type 1) to mite antigens. The intense pruritus leads to excoriation, resulting in exudation and even hemorrhage.

on the skin surface. This may lead to secondary bacterial infection and reduced growth rate in the long term (Wall and Shearer, 2001).

According to Soulsby (1982), *Demodexcanis* is the common follicle inhabiting mite of the dog and affects all breeds worldwide. The parasites are elongate, usually about 0.25 mm long; they have a head, a thorax which bears 4 pairs of stumpy legs and an elongate abdomen which is transversely striated on the dorsal and ventral surfaces. The mouthparts consist of paired palps and chelicerae and an unpaired hypostome. The penis protrudes on the dorsal side of the male thorax and vulva is ventral in the female. The eggs are spindle-shaped.

Demodexcanis lives as commensals, embedded head down in hair follicles, sebaceous and meibomian gland of the skin where they spend their entire lives. Females lay eggs in the hair follicle which give rise to hexapod larvae, in which each short leg ends in a single, three pronged claw. Octopod, protonymph, tritonymph and adult stages then follow. Immature stages are moved to the edge of the follicle by sebaceous flow, and it is here that they mature. One follicle harbours all life cycle stages concurrently. The life cycle is completed in 18-24 days. Demodex population is acquired by new born animals during the first few days of life from the bitch's mammary skin while suckling. The pathogenesis is thought to involve host immunosuppression (Wall and Shearer, 2001).

Two forms of the disease are usually recognized, a squamous form and pustular form. In squamous form, the hair follicles are distended with mites and cellular debris, the follicular epithelium is atrophic, hyperkeratosis is progressively evident. The hair may be separated or splintered or disintegrated. Hyperpigmentation occurs giving the skin a copper-red color. This condition progresses until large areas of the body are affected and the animal shows alopecia and thickened and wrinkled skin with "mousy" odor. The pustular form is preceded by the squamous form. It results from bacterial invasion (*Staphylococcus spp.*) of the dermis. Pustules or abscess formation with marked inflammation occurs. In extensive forms of canine demodicosis, death results from toxemia or emaciation (Soulsby, 1982).

In addition to localized and generalized demodicosis, Jasmin (2001) described the other forms such as Juvenile onset demodicosis (onset prior to puberty) and adult onset demodicosis. Juvenile onset is by far the most common, and is often self-limiting. Adult onset is usually associated with severe internal disease and is often very difficult to control. Squamous demodicosis (with no secondary infection) and Pustular demodicosis (pyodemicosis) where there is an associated pyoderma. Pododemodicosis is a demodicosis affecting the feet, generally pustular and often very refractory to treatment.

Most types of mange in pets can be eradicated, especially if they are treated early. Veterinarians diagnose mange with a painless skin scraping that is subsequently analyzed under a microscope. However, mange mites often burrow beneath the skin and the scraping does not include actual mites. Veterinarians actually inspect the skin sample for symptoms of mange rather than actual mites.

The usual treatment include special dips and/or baths with medicated shampoos or could be an injections administered by a veterinarian. Amitraz and Ivermectin are the treatments of choice for mange which really are expensive. Sometimes the use of these chemical controls is associated with the risk of side-effects or poisoning resulting from overdose, species sensitivity, breed sensitivity or an interaction between administered medicines (Wall and Shearer, 2001).

In connection to the above cited literatures, the researcher was pursued to study and discover the ectoparasiticide effect of VCO incorporated in soap to come up with an affordable mange cure for dogs.

METHODOLOGY

The Experimental animal

Fifteen mongrel dogs regardless of sex and age, and positive of mange were used in the study. They were distributed into five treatments and replicated three times with one dog per replicate following the Complete Randomized Design (CRD). The animals were properly labeled based on the treatment applied.

The following treatments were used:

T₀ - 60 % oil /100 g soap

T₁ – 1 ml amitraz/357 ml water

T₂- 50 % VCO/100 g soap

T₃ -60 % VCO/100 g soap

T₄- 70 % VCO/100 g soap

The extent of the severity of infestation was assessed prior to sampling using the skin scraping technique. Skin scrapings were taken from the experimental animals and were labeled according to treatment. The samples were examined under a compound microscope for positive identification of mange mites and were counted for pre-treatment mite count.

Skin Scraping Technique

Three sampling sites measuring 4 x 4cm were prepared by clipping the hair to expose the skin lesions. Mineral oil was applied thinly over the sampling sites. Using a sterile surgical blade the sampling area was scraped by holding the blade vertically and with a gentle sweeping motion the area was scraped covering as much as the clipped area as possible, until a slight capillary hemorrhage was evident. The scraped sample was spread evenly on a clean glass slide where a drop of mineral oil was previously placed. A cover slip was placed over the sample and was examined under the microscope to identify the mites and determine the mite count.

Preparation of Virgin Coconut Oil

Only matured coconut was selected for the preparation of VCO. The coconut water was collected and the meat was grated. With clean hands the coconut water and grated coconut were mixed together in a clean basin. A handful of the coconut mixture

was placed on a cheese cloth and was wringed 2-5 times to separate the cream from the mixture. The procedure was repeated for the rest of the coconut mixture. The coconut cream was filtered and transferred into a pitcher and covered. It was allowed to stand to allow the oil to separate from the cream and fluid. After which the liquid portion was discarded and the remaining cream and oil were put on a cheese cloth, and were hung to allow filtration and further extraction of the oil from the cream layer. The oil that dripped from the cheese cloth was collected and filtered until the oil was clear.

Preparation of plain soap

Palm Oil soap was made by placing water in the refrigerator to cool overnight until it reached a temperature of 4°C. The cold water was poured into a beaker and the desired amount of caustic soda was added stirring it gently; the resulting solution was called lye. Palm oil was carefully added in small drops while stirring constantly in one direction until the mixture thickened like honey. The thickened mixture was poured into a molder, covered with cloth or wax paper and was allowed to stand undisturbed for 1 - 2 weeks.

VCO soap was made by dissolving the desired amount of caustic soda to cold water. VCO was slowly and carefully added into the lye solution. The mixture was thoroughly mixed until thick like honey. The thickened mixture was placed into a molder. It was allowed to stand undisturbed for curing for 1-2 weeks.

Application of the VCO soap

The mangy dog was bathed with tap water to remove the scales and crust, and then VCO soap was applied liberally to form lather. The lather was allowed to remain in the coat for at least 15 minutes before it was rinsed. The application was done two times weekly for eight weeks.

Data gathered

Types of mites present. The types of mites were identified by examining the samples under the microscope before treatment with Virgin coconut oil soap.

Pre-treatment Mite Count. This was taken by counting the number of mites prior to first application of VCO soap divided by 3, the number of sites of skin scraping.

Post-treatment Mite Count. This was taken by counting the number of mites one week after each application and two weeks after the last treatment with VCO soap. The total number of mites was divided by 3, the number of sites of skin scraping.

Percent Efficacy of Virgin Coconut Oil soap. This was measured by subtracting the mean post-treatment mite count from the mean pre-treatment mite count divided by mean pre-treatment count multiplied by 100. The efficacy of Virgin Coconut Oil soap was based on the standard criteria by Riek and Kieth (1975) which are the following:

- a. 81 – 100% reduction of the count is highly effective.
- b. 60 – 80% reduction of the count is effective.
- c. less than 60% reduction of the count is ineffective

Other Observations

The experimental dogs were kept for observation after bathing with VCO soap to determine any adverse reactions of the dog to the VCO soap.

Statistical Design

The gathered data were tabulated using means and percentages. One way ANOVA (Analysis of Variance) was used to determine the differences among the five treatments

RESULTS AND DISCUSSION

Effect of VCO Soap Against Mites

Table 1 presents the efficacy of VCO soap on the mite count of dogs. It can be noted that the pre-treatment mite count of the dogs in the different treatments do not differ significantly which means that all the treatments are equal as to the severity of lesions.

It also shows decrease in the pre-treatment mite count of the dogs every after 2 wks of application based on the post-treatment mite count which indicates the efficacy of VCO soap on mites.

Treatment with Palm Oil soap (T_{0-}) made a slight decrease on the mite count from 12.11 to 8.89 with a mite count difference of 4.22 and a percent reduction of 34.84. The slight decrease could be due to the effect of palm oil on the mites. Treatment with commercial ant-mange Amitraz (T_{0+}) reduced the mite count from 39.89 to 0.00 with a mite count difference of 39.89 and a 100 percent reduction.

Table 1. Mite count difference and percent reduction of the different treatments after application with VCO soap

Treatment	Pre-treatment mite count	Post-treatment mite count	Mite count difference	Percent Reduction
T_{0-} - Palm oil	12.11a	8.89	4.22	34.84
T_{0+} - Amitraz	39.89a	0.00	39.89	100
T_1 - 50% VCO	21.44a	0.78	20.66	96.36
T_2 - 60%	34.78a	0.78	34.00	97.75

VCO					
T ₃	- 70%	24.78a	0.00	24.78	100
VCO					

*Means followed by the same letter are not significantly different at 5% level HSD

Treatment with VCO decreased the mite count of the dogs assigned to the different treatments. The 50% VCO soap (T₁) reduced the mite count from 21.44 to 0.78 with mite count difference of 20.66, and a 96.36 percent reduction. The 60% VCO soap (T₂) reduced the mite count from 34.78 to 0.78 with mite count difference of 34.00 and percent reduction of 97.75. While the 70% VCO soap (T₃) descended from 24.78 to 0.00 with a mite count difference of 24.78 and recorded a 100 percent reduction which is similar to the commercial anti-mange Amitraz.

Results indicate that VCO is effective in killing mites of dogs. This could be due to the the claim of Kabara (2004) that Monolaurin is the main active composition that makes the VCO soap an effective agent in killing the ectoparasites of dogs by penetrating deeply into the skin and into the cell structure of the connective tissues, and solubilizes or dissolves the lipids causing the disintegration of the covering or envelope of the disease causing organisms. They further claimed that with the cover torn down, the integrity of the pathogen is compromised resulting to death. The myristic acid in VCO works by dissolving the wax that covers the exoskeleton of the parasites, killing them by dehydration (http://www.answers.com/topic/myristic_parasites). It acts hand in hand with caprylic acid by dissolving the cell membrane causing changes in fluidity and permeability that lead to disaggregation as postulated by Fife (2001).

Most Effective Concentration of VCO Soap

The post-treatment mite count of the experimental dogs every after 2 weeks of treatment are shown in Table 2.

Table 2. Efficacy of the different treatments (%)

Treatment	Level of Significance	Post-treatment mite count (skin scraping every after 2 wks of application)				
		1	2	3	4	5
T ₀ - Palm oil		6.14c	13.20b	19.94b	27.19b	28.80b
T ₀₊ Commercial anti-mange		89.62a	98.77a	100.0a	100.0a	100.0a
T ₁ - 50 % VCO		49.61b	83.23a	96.83a	100.0a	97.78a
T ₂ - 60% VCO		82.17a	93.02a	93.49a	98.45a	98.91a

T ₃ - 70% VCO	79.39a	89.51a	100.0a	100.0a	100.0a
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*Means followed by the same letter are not significantly different at .05% level (DMRT)

+ - not significant

++- highly significant

Palm oil soap (T₀₋) was not able to totally (28.80%) eliminate the mites after 8 weeks of treatment. It can be noted that the different VCO preparations (50, 60 and 70%) equally reduced (97.78, 98.91 and 100% respectively) the mite count of the dogs similar to the leading commercial (T₀₊) anti-mange Amitraz (100%) based on the ANOVA from the 3rd to the 5th post-treatment skin scraping. This implies that all the VCO concentrations are equally effective in eliminating mites similar to the commercial anti-mange.

However, it is worthwhile to note that 70% VCO soap (T₃) was able to totally eliminate the mites on the 3rd post-treatment skin scraping (after 6wks of treatment or 12 applications) similar to the Amitraz (T₀₊) and the dogs remained mite-free even up to the 5th post-treatment skin scraping (10th wk of observation). Moreover, the 100 percent relief from the effects of mange accorded by 70% VCO soap (T₃) which was never offered by the other VCO treatments as early as 3rd post-treatment skin scraping justifies that it is the most effective concentration.

Lastly, it was also able to totally eliminate *Demodex*, the species of mite difficult to eliminate similar to the commercial anti-mange Amitraz which was not eliminated by the lower concentrations of VCO soap as shown in Table 4.

Efficacy of VCO Soap

Table 3 shows the efficacy of the various preparations of VCO Soap in treating mange in dogs.

After 6 weeks of treatment, 70% VCO soap attained 100 percent efficacy which is similar to the Commercial anti-mange (T₀₊) followed by 50% VCO soap (T₁) which recorded 96.83%, and 60% VCO soap (T₂) with 93.49% efficacy. Analysis of Variance, however, revealed no significant difference on the efficacy of the various concentrations of VCO soap with the commercial anti-mange preparation in dogs.

Results imply that all the different concentrations (50, 60 and 70%) of VCO soap were highly effective based on the standard criteria of efficacy by Riek and Kieth (1975) similar to the commercial anti-mange Amitraz in eliminating mites as compared with palm oil soap (19.94%) which had an ineffective rating.

The ectoparasiticide effect of VCO soap could be reflected from the documentation of Puotinen (2004) who reported that a pet owner tried using VCO to cure tick and flea and even mange of his dog. A couple of spoonful with each meal was introduced daily. Same benefit was claimed by Fife (2001), who stated that VCO kills lice and other parasites.

The synergistic action of lauric acid and other medium chain fatty acids (MCFA) particularly caproic acid present in VCO could be the reason why it is an effective ectoparasiticide (http://home.att/a_cat6P/org_mat_v.htm).

Table 3. Mean percent efficacy of the different treatments after 6 weeks of application

Treatment	Efficacy (%)
T ₀₋ - Palm oil	19.94b
T ₀₊ - Commercial anti-mange	100.0a
T ₁ - 50 % VCO	96.83a
T ₂ - 60 % VCO	93.49a
T ₃ - 70 % VCO	100.0a

*Means followed by the same letter are not significantly different at 5% level HSD

Species of Mites Affected by VCO Soap

Table 4 shows the species of mites identified during the pre-treatment mite count and post-treatment mite count.

Sarcoptes and *Demodex* species were the types of mites identified from the experimental dogs during the pre-treatment mite count.

Based from the results of the study, 50% VCO soap (T₁) and 70% VCO (T₃) eliminated *Sarcoptes* mites on the 6th week of application while 60% VCO soap (T₂) eliminated *Sarcoptes* mites on the 4th week of application. *Demodex* mites were eliminated by 70% VCO soap (T₃) on the 6th week of application. The 50% VCO soap (T₁) also eliminated *Demodex* mites on the 8th week of application but had recurrence two weeks after the last treatment. Recurrence of *Demodex* mites was identified from the skin scrapings of replicate dogs treated with 50% VCO soap. As cited by Jasmin (2001), when relapses or recurrent cases occur, it suggests that either the therapy was too short, or that there has been reinfection from the environment or another infected animal.

Results indicate that 70% VCO soap can eliminate both *Sarcoptes* and *Demodex* species of mites similar to while, 50% and 60% VCO soap can only kill *Sarcoptes* species within the duration of the study.

Table 4. Species of mites affected by VCO soap

Treatment	Pre-treatment replication			Post-treatment skin scraping (weeks)				
	I	II	III	2	4	6	8	10
T ₀₋ - Palm oil	S	S	S	S	S	S	S	S
T ₀₊ - Amitraz	S	D	S	S/D	D	-	-	-
T ₁ - 50% VCO	S	D	S	S/D	S/D	D	-	D

T ₂	- 60% VCO	S	D/S	D	S/D	D	D	D	D
T ₃	- 70% VCO	S	S	D	S/D	S/D	-	-	-

Legend: S - Sarcoptes D/S – Demodex and Sarcoptes D - Demodex
 -- None

CONCLUSIONS

Based from the results of the study, the following conclusions were derived:

1. VCO soap is highly effective in treating mange in dogs;
2. Seventy percent (70%) VCO soap is the most effective concentration in treating mange in dogs; and
3. *Sarcoptes* and *Demodex* species of mites in dogs are killed by 70 % VCO soap while only *Sarcoptes* species is killed by the lower concentrations of VCO soap.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

1. VCO soap is recommended for the treatment of mange in dogs;
2. VCO soap should be used regularly especially for dogs with demodectic mange;
3. Information dissemination should be conducted to inform dog owners of the efficacy of VCO soap against mange;
4. Commercialization of VCO soap is recommended;
5. Further study should be conducted to verify the efficacy of VCO soap against other ectoparasites of dogs; and
6. A study should be made to determine the efficacy of VCO soap against skin diseases of dogs.

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