



Mosquito Magic™

The Effective DEET Free
Insect Repellent Alternative!

Preliminary Report on the Efficacy and Longevity of Mosquito Magic Formula and Three of its Formulated Products: The Granular Shaker, The Soap, and The Clip.

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October 20, 2002

Summary

Mosquito Magic is an effective mosquito repellent. It has a pleasant aroma and its products offer a wide range of application and use. It is composed of natural compounds, fragrances, and oils that are “user friendly” and pose a low amount of risk during use to both the individual AND the environment. Efficacy rates ranged from 69% to 100% depending on which Mosquito Magic product was used and other uncontrolled factors. Longevity as measured by the “smell half-life” ranged from hours to days to weeks depending on the Mosquito Magic product and the way it was used. If someone were to ask me what kind of repellent would I choose to use, Mosquito Magic would definitely be on the top of my list of recommended products. I highly recommend its use over other repellents.

I. Introduction

I met Mike Spargo of Spargo Enterprises in September 2002 after responding to an email letter of inquiry that he had sent to the Gaston College Science Department requesting help from someone with experience with insects and insect behavior. Since my Doctoral Degree [Ph.D.] is in the field of Entomology from Ohio State University, and, since my graduate work specifically involved aspects of medical entomology [blood-feeding ticks], I offered to do standard scientific testing of the product for Mr. Spargo.

In my past experience in research, I have performed ecophysiological and behavioral studies on blood feeding ticks and their abilities to survive water stress. I did water balance physiological studies on five species of tick, including the primary vector for Lyme disease. This mostly involved studying the effects of differing humidity's on tick behavior and physiology. My research protocols have been used in other labs that also study tick biology. I have participated in studies involving house dust mites, which cause dust allergies, as well as a pest species of mite that invades and destroys honeybee hives. For my master degree in biology, I also did water balance physiology studies on mound-building ants using radioactive water to trace water flux rates in individual workers. In my personal experience with mosquito repellents, I have, in the past, performed other personal tests with both pure citronella oil, citronella candles, and products containing deet. Although the Deet product was effective in repelling mosquitoes, I stopped using it because I had experienced contact dermatitis [rash] on my skin after it was applied. My son, who also had Deet applied to his skin, recently, experienced a rash also, especially when using a product having the highest quantity of Deet. I found that the use of citronella candles was effective only if I were sitting in the “fragrance plume” from the candle. Otherwise, I found that mosquitoes would still land on me. The application of pure citronella oil to my skin was more effective than the candle. However, the smell of pure citronella is strong and “overpowering”.

During our initial meeting, he expressed a desire to have someone like myself do a preliminary assessment of the effectiveness [efficacy] and longevity of three mosquito repellent products that are produced and marketed under the name “Mosquito Magic” [MM]. Information about the MM product was sent to me [1]. I agreed to undertake the task of conducting initial and preliminary tests on MM products and report my findings to him and his company. It should be emphasized here that this report represents only preliminary tests, and although there is data presented that supports the stated mosquito repellency of MM, these are only preliminary assessments and would require further, more rigorous, scientific research on the MM products.

It is customary and standard in field tests to test the products in a certain way, and I did that with consideration to the wide variability of several factors that would influence the examination of an insect repellent; including changes in weather conditions, wind speed, temperature, humidity and location. I also wanted to try to be as much of a “normal” consumer as possible, wearing clothes that were suitable for the season [shorts and short sleeve shirt] and yet, be able to monitor the skin of my legs and arms for mosquito attraction in the form of landings. I decided not to kill or capture the mosquitoes during the tests. Instead I simply used my finger to get them to fly away without harming them.

II. The Mosquito Magic Products and Testing Protocol

My preliminary tests were on three MM products, as well as on the pure formula provided in a small squeeze bottle. The effectiveness of insect repellents as well as the MM product is based upon a chemical fragrance that can repel insects, especially mosquitoes. What is exciting about MM is that the fragrance that has been developed is unique and is “all natural”. Other repellents on the market have been used, and they primarily contain either chemicals such as deet, ir3535, and citronella oil. The purpose of my tests is to see if MM products are as good or better than repellents currently on the shelf.

All of the products used, I was told, were approximately 18-19 months old [unopened on the shelf]. The MM products use a fragrance “blend” made from a combination of substances that have been documented by the EPA as established mosquito repellents [2]. Newly produced MM products should, therefore, prove to be more potent and effective. The MM label shows its ingredients as a mixture of the following 11 mosquito repellents listed by the EPA as minimum risk pesticides [2]. The following ingredients in MM are listed in order of decreasing quantity used in the formula: geraniol, lemongrass oil, cedar oil, citronella oil, clove oil, rosemary oil, peppermint oil, cinnamon oil, thyme oil, geranium oil, and mint oil. Two factors were examined using the MM products, the efficacy and longevity. All of these components are “all natural” ingredients.

A. Efficacy

The general protocol that was used to provide initial information regarding the efficacy of MM products is as follows;

Step 1. The degree of mosquito contacts would be determined by counting the number of mosquitoes actually landing on the skin of my legs and arms in an approximate 6-minute period, and in a designated location. During this time only mosquitoes landing on the skin were counted, and not mosquitoes landing on clothes.

Step 2. After Step 1, one of the MM products was applied or utilized as directed, and then I return to the same location as in Step 1. The number of mosquito skin-landings in another 6 minutes period was then counted. Note that careful observations were made of mosquito landings on the skin opposed to the clothes. This was done because some of the MM products were applied only to the skin.

Step 3. The specific location where the test was performed and other observations will be noted for each test and product. The date and time of day were recorded, as well as the general meteorological conditions such as temperature, wind speed, cloudy, rainy, or sunny, and other factors as noted.

B. Longevity

Since it is the fragrance of MM that makes it a repellent, and since the MM formula is exclusively unique in its formulation, then how long the fragrance lasts would correlate with longevity of the repellents effectiveness. Longevity of the product was determined by applying the product and then [after waiting a prescribe period of time, usually five minutes], returning to the site of application and smelling the degree of aroma at the beginning and assigning that degree of smell as a “Plus 5 or “+++++”]. I then periodically returned to the site and would re-test for smell and assign the number of pluses relative to how much or how strong the fragrance was compared to the beginning [as in +++++, +++++, +++, ++, +, and 0, where zero represented no smell at all]. The amount of time when approximately one-half of the smell “strength” remained was used for the purposes of establishing longevity [in other words the “smell half-life”]. This approximate “half-life smell time” was used to compare MM to a report in the New England Journal of Medicine [NEJM] on the longevity of 16 mosquito repellent products [3]. It must be emphasized here that my comparison is made using a different protocol as used in the NEJM report. Nevertheless, the time comparisons are used in this report to compare the time length that MM’s fragrance may be still effective relative to the other repellent products examined in the NEJM report. I did not test for longevity concurrent with efficacy. Since it was the fragrance that repelled mosquitoes, I assumed that a “reasonable degree” of smell [i.e. approximately one-half of it’s original strength based on my own subjective determination] of the MM product would be still effective at repelling mosquitoes.

Additions, modifications, and/or changes in this general protocol will be stated under each product discussed.

III. The Pure Formula - Efficacy

The pure formula was used to establish that the MM formula works by testing its efficacy. A count of mosquito landings on my skin was first established. Then, a 1 ml pipette was used to administer approximately 1.0 milliliter of the pure formula into a small test tube. Then the oil was applied to the skin using the fingers. After application of the oil, I returned to the mosquito site and there was a 100% decrease in the number of mosquitoes landing on the skin [17 lands per 6 minute period compared to 0 lands per 6 minute period]. It works!! It did indeed repel mosquitoes.

The location used for this test was the backyard of the Sigal residence at 401 Kelford Lane, Charlotte, North Carolina 28270. Note that the back of the property is adjacent to a wooded natural area, which

drops down to become a federally designated “100 Year Flood Zone” on the property’s survey map. This area is adjacent to a neighborhood rain-water culvert that empties out as a small creek in the Sigal backyard and then terminates and becomes part of a temporary, flood plain, wetland ecosystem. This periodic wetland is an ideal place to find mosquitoes [OR FOR THEM TO FIND YOU!!!] under proper seasonal and environmental conditions, and I used this site for some of the MM tests.

Since my understanding is that the pure formula is not sold as a commercial MM product, I, therefore, did not test its longevity.

On a personal note; “Wow! Super Product! Was I impressed!! It worked great!!!” Also, I had no adverse health effects with the use of the pure formula, or any of the other products used in this study.

IV. The Mosquito Magic Soap - Efficacy

This product was also highly successful in repelling mosquitoes. It has twice the formulated amount of active ingredients as either the granules or the clip. For this test, the soap was applied to the skin like a deodorant bar rather than as a soap [i.e. with water]. The bar was opened and the bar of soap was simply rubbed over the skin of the legs, arms, and neck, much like a roll-on deodorant stick. Once I established a count of mosquito landings using my untreated self, the soap was then applied to the skin. After application of the soap, I returned to the mosquito site and there was a 100% decrease in the number of mosquitoes landing on the skin [11 lands per 6 minute period compared to 0 lands per 6 minute period]. I also did this same test with my son, and he had a 75% reduction in mosquito landings after the soap application.

This same test was repeated another time and the location was within a forested area close to the Sigal residence, but further into the natural area of the McAlpine Greenway Park that contains the wetlands stated above. There was a 94% decrease in the number of mosquitoes landing on the skin [17 lands per 6 minute period compared to 1 lands per 6 minute period].

The location used for this test was the backyard of the Sigal residence as stated in section III above.

On a personal note; I was very much impressed with the soap. It really did keep the mosquitoes at bay. My son, while helping me during the test said it was “amazing!”

V. The Mosquito Magic Granules - Efficacy

The granular form of MM was tested to establish its efficacy. Once there was an established count of mosquito landings, a measured quantity of granules was first poured into a measuring cup of known volume and then dispensed as stated in the two tests listed below.

In the first test, the location of the Sigal residence in the backyard was used. About 1 1/3 cups [or approx. 266 grams] of granules was sprinkled over a

11 x 10 foot partially shaded plant and leaf litter area and then, after 5 minutes, the number of mosquito landings were recorded. There was an 82% decrease in the number of mosquito landings [11 lands per 6 minute period compared to 2 lands per 6 minute period]. My son, who was also counting mosquito landings on himself had a 69% decrease [16 lands per 6 minute period compared to 5 lands per 6 minute period]. In this test, no other form of Mosquito Magic product was applied to the body, and only the efficacy of the dispensed granules on the ground was monitored.

In a second test, at a location of backyard of the Sigal residence, but in a previously untreated area of the backyard, about 1 and 1/2 cups [or approx. 299 grams] of MM granules were dispensed over a 16 x 11 foot area. After waiting about 5 minutes, the numbers of mosquito landings were recorded. There was a 76% decrease in the number

of mosquito landings [17 lands per 6 minute period compared to 4 lands per 6 minute period]. In this test, no other form of Mosquito Magic product was used, and no other form of Mosquito Magic product was applied to my body. Only the efficacy of the dispensed granules on the ground was monitored.

VI. The Mosquito Magic Clip - Efficacy

The MM Clip was first tested to establish its efficacy, and then tested for longevity separately as stated in Section VII below. The location was within a forested area close to the Sigal residence, but further into the natural area of the McAlpine Greenway Park, which contains the wetlands as stated earlier. Once there was an established count of mosquito landings using my untreated “self” to count mosquito landings, I left the area and the clip was opened and attached to the belt. After a 5-minute wait, I returned to the site of the test and again counted mosquito landings. There was 71% decrease in the number of mosquito landings on the skin [17 lands per 6 minute period compared to 5 lands per 6 minute period].

It is reported that field tests of the efficacy of a repellent or pesticide are hard to quantify and measure [4], and results can be quite variable due to a range of factors that can ultimately affect the data collected. In my experiment, for example, I DID NOT walk around [i.e. to simulate hiking] with the Clip even though that is the intended design of the MM Clip. Instead, I remained relatively stationary within a small location in order to better and more accurately count the number of mosquitoes landing on my skin. Such a task would be hard to do if one were hiking through the forest or walking in a park. Furthermore the “local” mosquito population that lands on untreated skin was established in a particular location and so testing and counting was done in that same location. One of the exciting features of the MM clip is that it is designed to release more fragrance [repellent] if the temperature is higher, and the higher the temperature, the more mosquitoes. With this novel design feature, the MM Clip would provide greater protection when there are more likely to be more mosquitoes! What a great match between a biological phenomenon and a technical innovation of a repellent product!

VII. Longevity of Mosquito Magic Products

Due to the constraints of time and the lack of use of controlled laboratory experimental conditions, not all of the MM products were tested for longevity. Since it had been established that MM did indeed repel mosquitoes by virtue of the fragrance it produced, the length of time in which the fragrance disappeared was the only factor examined, and not whether mosquitoes were repelled throughout the entire time of the products’ fragrant output. The assumption is made that even at lower levels of fragrance, the MM products would still repel mosquito to some degree. Therefore, the time period designated, as the “smell half-life” did not determine whether mosquitoes were indeed repelled at those levels of fragrance, but rather, was determined for this report as a means of assessing just how long the fragrance lasted. Obviously, the results presented here were affected by a number of ambient factors such as temperature, humidity, and wind speed.

A. The pure formula

The pure formula was not tested for longevity since it is not used as a MM commercial product

B. The MM soap

The MM soap was also not tested for longevity. This was due to time constraints and to the unconventional way in which it was applied as stated in section IV above. However, since it has twice the

quantity of active ingredients relative to the other MM products, it logically follows that the soap may retain its fragrance longer than the other products. As a personal note, I did apply the soap to my socks during one of the experiments and these articles not only had no mosquito landings, but they still retained the MM fragrance a week later when they were taken to the laundry.

C. The MM granules

For this first test, a small amount of granules [22.4 gms] were poured onto a paper plate and spread out into an even layer of granules, and then set out on the second floor outside deck of my apartment home in Charlotte, North Carolina 28270. Subsequently, assessments of smell using the “0-5 plus” method as described in the Section II longevity protocol were performed over time. The smell half-life for this particular test was 270 minutes [4 1/2 hours]. Using a report in the New England Journal of Medicine describing the mean length of protection for 16 repellents [3], the smell half-life of the MM granules in this trial was second only to a repellent containing 23.8% DEET, which had a mean protection length of 301.5 minutes. I would point out that two different protocols to determine longevity were used, and the MM trial was a single experiment and would require further, more rigorously controlled testing. Also, only longevity was determined in my test, with no measurement of repellency.

In a second test, 365.7 grams [or 2 1/6 cups] of MM granules were dispensed over a 24 x 9 ft area located on a cement landing behind the Rauch Science Building at Gaston College, Dallas, North Carolina 20834. Subsequently, assessments of smell using the “0-5 plus” method as described in the Section II longevity protocol were performed over time. The smell half-life for this particular test was 205 minutes [3 2/5 hours]. When compared, as in the first test above, to the 16 other repellents [3], this test was the third highest in longevity, with times about 12% less than a repellent containing 20% DEET.

It should be stressed again that several factors may affect the longevity of the MM fragrance in the field, such as quantity or volume of granules used, temperature, wind speed, humidity, application substrate [i.e. grass versus soil versus cement], and cloud cover [versus sunlight] may play a role in determining the length of time that the MM fragrance remains in a given area.

D. The MM Clip

To test the longevity of the MM Clip, the clip was opened up and placed on a chair on the second floor outside deck of my apartment home in Charlotte, NC. Subsequently, assessments of smell using the “0-5 plus” method as described in the Section II longevity protocol were performed over time. In this test, the clip was left opened continuously, even throughout the night [although it is recommended that the Clip be replaced in a seal able plastic bag when not in use. The smell half-life for this particular test was about 14,400 minutes [approx. 10 days, or 1.4 weeks]. It should be pointed out again that many factors as described in Part C above play a role in the longevity of fragrance for the MM Clip. This product by far had the greatest longevity, and using the report in the New England Journal of Medicine describing the mean length of protection for 16 repellents [3], the smell half-life of the MM clip was 47 times greater than the repellent with 23.8% DEET. As an additional note, the MM Clip had a noticeable increase in smell compared to previous readings. This occurred when the temperature rose to higher daytime temperatures relative to the night or morning. During this particular trial, there were several days when the weather was very cool [temp. = 18-20 °C] and rainy, and the smell “score” was only 1+. However, a couple days later, the skies cleared and the temperature rose back up [temp. = 29-33°C], the smell “score” was back up to 3+.

VIII. Conclusions

I was extremely impressed with this product line. Its aroma was pleasing and I saw, first hand, how effective it was in repelling mosquitoes. As both a scientist who has been involved in testing products and an "average" consumer, I can say with great enthusiasm that Mosquito Magic products did a fabulous job of repelling mosquitoes! I highly recommend it due to the fact that it is made with natural ingredients and is, therefore, safer to use with less of a risk to human health compared to other repellents that require some sort of caution or warning about the proper application and use of the active ingredients. Furthermore, because Mosquito Magic ingredients are natural, it is more likely that these components would cause less harm to the environment.

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X. Resume of Dr. Sigal

MARVIN DAVID SIGAL, Ph.D.

Education:

Doctor of Philosophy. 1990. Department of Entomology. The Ohio State University, Columbus, Ohio.

Master of Science Degree. 1979. The Department of Biological Sciences. Wright State University, Dayton, Ohio.

Certificate of Accomplishment. Intensive Workshop on Laser Holography. 1979. Lake Forest College, Lake Forest, Illinois. First and Second International Symposium on Display Holography. July 1982 and July 1985. Department of Physics, Lake Forest College, Lake Forest, Ill.

Bachelor of Science Degree. Vertebrate Physiology & Zoology 1975. College of Biological Sciences, The Ohio State University, Columbus, Ohio.

Experience:

Faculty. Department of Science. Gaston College, Dallas, North Carolina. September 1992 - Present. [Served as acting-chair, Summer, 1999]

Program Specialist, Charlotte-Mecklenburg Board of Education After School Enrichment Program [ASEP]. 1994-Present.

Adjunct Faculty. The Art Institute of Charlotte, Charlotte, North Carolina. 2002.

Lecturer. 1996-1997. Discovery Place [Science Museum], Charlotte, North Carolina.

Adjunct Faculty. Otterbein College, Westerville, Ohio. 1990 - 1992. Head Tennis Coach. 1991 Women's Tennis Team. Otterbein College. DNA Transfer Workshop. Ohio College Biology Teachers Conference. Otterbein College. Oct. 1990.

Adjunct Faculty. 1980 - 1992. The Department of Biological and Physical Sciences, Columbus State Community College, Columbus, Ohio.

Adjunct Faculty. The Pontifical College Josephinum, Columbus, Ohio. 1990 - 1992.

Lecturer. Medical/Veterinary Acarology. The Acarology Summer Program. Summer, 1990. The Ohio State University, Columbus, Ohio. Research and Teaching Assistant for the Acarology Summer Program, Summer 1989. Acarology Laboratory, Department of Entomology, The Ohio State University, Columbus, Ohio.

Administrative Assistant to the Graduate Committee Chairperson. March 1988 - June 1989. Department of Entomology, The Ohio State University, Columbus, Ohio.

Chairman of the Entomology Graduate Students Association. 1986 - 1988. Department of Entomology, The Ohio State University, Columbus, Ohio.

Faculty Committee Representative for the Entomology Graduate Student Association. 1988-1989. Department of Entomology, The Ohio State University, Columbus, Ohio.

Graduate Teaching Assistant. September 1985 - March 1988. Department of Entomology, The Ohio State University, Columbus, Ohio.

Graduate Teaching Assistant. 1976 - 1978. Department of Biological Sciences and Department of Environmental Sciences, Wright State University, Dayton, Ohio.

Curator/Research Assistant. June 1987 - Dec. 1987. Department of Entomology, The Ohio State University. Columbus, Ohio.

President and Primary Researcher. 4-D Images Company, Columbus, Oh. 1980 - 1986. Research, development, and production of laser-generated, white-light reflection holograms. 1986.

Holographic Textbook Project. 1985 - 1986. Designed, created, and produced a holographic book of the cat skeleton. Department of Biological and Physical Sciences, Columbus State Community College, Columbus, Ohio.

Environmental Scientist II. Division of Water Quality, Planning, and Assessment, The Ohio Environmental Protection Agency, Southwest District Office, Dayton, Ohio. 1978.

Electron Microscopy Researcher and Technician. 1977 and 1978. The Department of Biological Sciences, Wright State University, Dayton, Ohio.

Grants:

Gaston Job Ready Partnership Grant. \$1000. 1999.

Initial Phase Planning Committee, Project Discovery (National Science Foundation), Central Ohio Region. Spring and Summer, 1992.

Co-Writer. Ohio Environmental Education Fund. Ohio Environmental Protection Agency. Submitted Dec. 1991.

Writer. Ohio Board of Regents; Dwight D. Eisenhower Science and Mathematics Education Program Grant. 1990-1991. Otterbein College, Westerville, Ohio.

Writer. Ohio Board of Regents - Dwight D. Eisenhower Science and Mathematics Education Program Grant. 1991-1993. Otterbein College, Westerville, Ohio.

Publications:

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Abstracts and Presentations:

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Lasers and Holography. M. D. Sigal. Discovery Place, Inc. [Science Museum]. Charlotte, North Carolina 28202. July 7, 1995

Awards and Honors:

Exhibitor: Tiger's Eye. July 17-August 15, 1982. In; International Exhibition of Holography, Sonnenschein Gallery, Durand Art Institute, Lake Forest College, Lake Forest, Illinois.

Exhibitor: Holographic Book of the Cat Skeleton. Jan. 20-31, 1992. In; Holograms: Three-Dimensional Works in Light, Hopkins Hall Gallery, The Ohio State University, Columbus, Ohio.

Third Place Award Winner. Doctor of Philosophy Category, Fourth Annual Forum and Student Paper Competition. Title; Laser-generated Holograms as an Educational Tool in Entomology. The Ohio Valley Chapter, American Registry of Professional Entomologists, April 1989. Ball State University, Muncie, Indiana.

First Place. Graduate Student Awards Competition. Paper title; Holograms as an Educational Tool in Entomology. 44th Annual Meeting, North Central Branch of the Entomological Society of America, March 12-15, 1989, Indianapolis, Indiana.

DeLong Award Recipient 1988. Department of Entomology, The Ohio State University. Paper title; Comparison of Water Balance Physiology of a 1-host and 3-host ixodid tick. Competitive departmental award, which pays for all travel and conference expenses to the National Meeting of the Entomological Society of America.

Graduate Leadership and Recognition Award. 1987. Department of Entomology, The Ohio State University.

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