IOSR Journal of Applied Chemistry (IOSR-JAC)
e-ISSN: 2278-5736.Volume 14, Issue 8 Ser. I (August 2021), PP 15-20
www.iosrjournals.org

Comparism of Repellent Produced From Grape and Orange Peels

[1*]Adepoju, M.A., [1]Taiwo, A. A., [1]Ogunnaike A.E., and [1]Salami,A.A.
[1]*Department of Science Laboratory Technology,*
Moshood Abiola Polytechnic, Abeokuta, Ogun State

Abstract
The activities of mosquito repellents produced from peels of orange and grape fruits were compared. The extracts of Citrus fruit peels were air-dried and powdered, soxhlet method was used for the extraction with diethyl ether as solvent. Three different repellents (Candle, Cream and liquid) were produced from each extract. Application of the products on human volunteers showed that the products repelled mosquitoes and other insects effectively. This study revealed that some phytochemical compounds found in the extracts were active ingredients which made the prepared repellents effective on all species of insects without having any harmful effect on the users. There were no significant difference in the results of physico-chemical parameters and repellent properties of the two studied citrus fruits.

Key Words; *Production, Mosquito repellent, Orange, Grape, Peels.*

Date of Submission: 04-08-2021 Date of Acceptance: 18-08-2021

I. Introduction

Mosquitoes are commonly found in African countries, they are responsible for malaria, yellow fever and dengue fever, these diseases are very deadly if not properly treated. WHO reported about 15,000 deaths per annum in India,this embraced all ages. Mosquito control measures need to be put in place in urban and rural areas, the best way is to restrain their breeding by using non-hazardous chemicals (Neeraj Dhingra *et al.,* 2010). Mosquito repellents available in the market have formulations with remarkable safety profile, but their toxicity against the skin and nervous system can cause rashes, swelling, eye irritation and other serious problems to children (Neeraj Dhingra *et al,* 2010). This led some researchers to bio-based natural mosquito repellents which is preferable to chemically prepared ones. Bio based mosquito repellent are based on bio active ingredients derived from plants. These bio based products play important role in controlling pest in areas where mosquito resistance, and environmental concerns limit the use of products. Some of these mosquito repellent are prepared from the following; Basil (Ocimum basilicum), oils of Castor, Cedar, Clove, Fennel, Citronella (Trongtokit *et al.,* 2005), Eucalyptus, Neem (Caraballo *et al.,* 2000), Rosemary and Catnip oil of Nepeta species which have nepetalactone, Celery extract (Apium graveolens) and Solanum villosum berry juice. These natural resources are good for the environment and also have good flavour (Muller *et al.*, 2008).

Mosquitoes are attracted towards man because of the presence of lactic acid and Carbon (IV) Oxide in human sweat. The attraction is caused by Chemo-receptors present in the antennae of mosquitoes which perceive the smell of the sweat. The special role of natural mosquito repellent is to mask human scent. Most plants contain compounds that can be used to prevent attack from plant eating insects. These can be categorized as repellents, feeding deterrents, toxins and growth regulators. Repellents from plant origin is not hazardous to human and domestic animals, they are easily biodegradable. Natural products are safe for human when compared to that of synthetic compounds (Patel and Oswal 2012). Hence , there is need to launch extensive search to explore eco-friendly biological materials for control of insect pests.

.

JUSTIFICATION

Reports from researchers showed that the smoke generated from mosquito coil is dangerous to health, this may lead to severe headache, nausea, respiratory impairment and vomiting, the condition may be severe with asthmatic patients. Therefore, it becomes imperative to produce mosquito repellents that are not harmful to man's health with the use of bio degradable product of plant to control mosquito bite and infections

II. Materials And Methods

SAMPLE COLLECTION AND PREPARATION

Fresh orange and grape fruits were purchased from popular markets in Abeokuta, Ogun State, Nigeria. The orange and grape fruits were washed in water, dried, peeled, and the peels were chopped with a knife and washed in water, the peels obtained from the fruits, were spread on a clean ply wood and air dried. The dried peels were grounded into powdery form using a manual grinding machine and stored in an air tight container.

EXTRACTION

1kg of the powdered sample was weighed into a 2L soxhlet apparatus containing 1000 ml of diethyl ether. The citrus oil extraction was done at temperature range of 50^{O}C to 70 ^{O}C for about 6 hours. The extract was left over night in order to cool down the temperature and to allow the remaining diethyl ether to evaporate.

REPELLENT CREAM PREPARATION

Petroleum jelly and paraffin wax were measured into the pot; the mixture was heated and allowed to melt. Lanolin, glycerin, vitamin E, mineral oil, Shea butter and Coconut oil were added and stirred thoroughly. The mixture was allowed to cool, fragrance and colour were added, and the resulting mixture was thoroughly mixed. When warmed the extracted oil was added to the mixture, thoroughly mixed before pouring into a container.

LIQUID REPELLENT PREPARATION

The oil from citrus fruit contains limonene, the extracted oil from the citrus rinds was used to prepare insecticide, and citrus oil is all that is needed to make insecticide spray. The peels were dried, grounded and was soaked in alcohol, the mixture was strained leaving the alcohol to get evaporated.

REPELLENT CANDLE PREPARATION

The candle was made from mixture of solid paraffin and stearic acid as hydrocarbon base. Solid paraffin and stearic acid were heated to a temperature of 700 ^{0}C until they melted, essential oil was added, this made the temperature dropped between 550^{O}c – 600^{O}c. Active ingredients Cucurmin were then added to separate formulations. The wick was inserted in the liquid wax,so as to obtain the required diameter. It was poured into a cup shaped mould, which was then filled with liquid wax. After cooling the solidified candle was removed from the mould.

PHYSICO-CHEMICAL ANALYSIS OF THE EXTRACTED OILS

SOLUBILITY

Four drops of extracted grape peels oil was added to the test tube containing 8 drops of water. The mixture was stirred thoroughly with glass rod. The mixture was allowed stayed for 5 minutes. Two separate liquid phases were observed. The pH of the water phase was measured to check for the solubility of the essential oil in water. The above experiment was also carried out on orange peels oil. (Hognadottir *et al*., 2003).

BOILING POINT

5 ml of extract ed oil from grape peel is placed a small test tube, a capillary tube with sealed end is placed inside the test tube with the closed end upward. The test tube is clamped to a ring stand, and a thermometer was attached to it. A 250 ml beaker was half filled with water, and placed on the hot plate. The test tube containing the mixture and thermometer were carefully lowered into the beaker of water. The mixture was heated slowly on a hot plate. few bubbles were observed flowing out of the end of the capillary tube as the oil approaches its boiling point. When steady streams of bubbles were observed, the temperature at which the oil began to flow into the capillary tube was recorded. The above experiment was repeated for orange peels oil. (Hognadottir *et al., 2003).*

SPECIFIC GRAVITY

A dry density bottle of 25 ml capacity was weighed to give initial weight of W0. It was filled with water and reweighed to give (W_1). The water was drained and bottle was clean . It was then filled with grapefruit essential oil and weighed to give (W2). The specific gravity was then determined from the following equation. The above experiment was carried out again using grape essential oil (Hognadottir *et al., 2003).*

$$Specificgravity = \frac{W_2 - W_0}{W_1 - W_0}$$

REFRACTIVE INDEX

Abbe's refractometer was used for the determination of refractive index of the oils. There refractive index is denoted by $^{n}{}_{D}{}^{25}$where n is the refractive index at 25°c taken with sodium light (D-line). The refractometer was calibrated with distilled water (RI of 1.3330 at 20°C/68°F and 1.3325 at 25°C/76°F) which has refractive index of$^{n}{}_{D}{}^{29.5}$ =1.3315. The glass prism was wiped clean using cotton pad which was earlier moistened with acetone . A drop of grape peels oil was placed between the prisms of refractometer and allowed time for temperature equilibrium between the instrument and the sample. The telescope was rotated to bring the border line of total refraction other junction of cross-wire in the telescope. The refractive index was recorded at room temperature. The above experiment was repeated for orange peels oil (Maria *et al.*,2012).

ACID VALUE

10 g of the extracted grape oil was weighed into a dried conical flask. 50 ml of ethyl alcohol was added into the conical flask and 3 drops of phenolphthalein was added to it. The solution was titrated against 0.1N KOH until the end point is reached, (pink colour). The volume of KOH used in the titration was recorded. (Maria *et al.,* 2012). The above process was repeated with for orange peels oil. The acid value was calculated with the equation:

$$\text{AV (mg KOH/g sample)} = \frac{56.1\ xVxN}{m}$$

Where, V – Titre volume of standard potassium hydroxide solution (ml);

N – Normality of the potassium hydroxide solution, m – Mass of oil sample (g)

SAPONIFICATION VALUE

2g of grape peels oil was weighed into a 250 ml conical flask, to which 50 ml 0.5 M alcoholic KOH was added. The mixture was constantly stirred for 1 hour this was followed by reflux. 3 drops of phenolphthalein indicator was added and titrated with 0.5 M HCl until the pink coloration disappeared. (Maria *et al.,* 2012). The procedure was repeated for orange peels oil. The saponification value was calculated with the equation:

$$\text{SV (mg KOH/g sample)} = \frac{[(S-B)\ X\ M\ X\ 56.1]}{\text{Sample Weight}}$$

Where, S = sample titre value (mL), B = blank titre value (mL), M = molarity of the HCl

III. Results And Discussion

The physicochemical properties of grape and orange peels are presented in Table 1. The specific gravity of the two samples are similar (0.791 grape and 0.811 orange), this is similar to the result presented by (Fashola *et al.,* 2016), they reported 0.84540 for grape and 1.8429 for tangerine. (Barkatullah *et al.,* 2012) also reported a close value of 0.79g/ml for *Skimmia laureola* oil. In the other hand, higher value of 1.995g/ml was reported by (Olagunju 2013) for mango seed oil. The refractive index for the two samples were 1.43 and 1.512 respectively, these are also close to the value by (Fashola *et al.,* 2016), 1.473 grape and 1.476 tangerine. (Akinhanm *et al.,* 2008) also observed lower refractive index of 1.201 for cashew seed oil. In the same vein, (Adelaja 2006) also reported lower refractive index (1.13) for coconut oil. Refractive index shows the stability of oil during thermal treatment and the level of saturation of oil (Olagunju, 2013).

The boiling points ranges from (171^{o}c to 179^{o}c) the two sample are insoluble in water but soluble in organic solvent (Schumann *et al.,* 2005). The boiling point of a liquid varies, this depends on the environmental pressure (Olagunju, 2013).

The acid value for the samples observed for orange peels were 17.3 mg KOH/g while 15.33 mg KOH/g for grape, the observed value is lower than acid value (31) reported for edible oil (Siekmann 2005). The result obtained in this result is higher than 0.39 – 0.86 mg KOH/g oil and 0.16 – 0.60 mg KOH/g oil reported for groundnut oil and palm oil respectively by (Babatunde and Bello, 2016).Acid value is an important physicochemical property index of oil which determines the edibility and suitability of oil for industrial use such as paint (Akubugwo *et al.,* 2008). This value is used to measure the extent of glycerides in the oil, which have been decomposed by lipase and other physical factors such as light and heat (Demian, 1990).

Saponification value observed is 180.3-190.56 mg KOH/g which is greater than saponification value observed for edible oil, palm kernel oil 0.2503, pea nut oil 0.1925, palm oil 0.2000 (Gunstone *et al.,* 2016).The value observed for saponification is close to value reported for soap making oil coconut oil 191.1, olive oil 135.3, soy bean oil 135.9 castor oil 128.6 (Hognadottir and Russell, 2003).Saponification value shows the average molecular mass of various fatty acids in oil samples. The lower value of saponification indicate molecular weight of fatty acids is lower and has lower limit of use in industry (Denniston *et al.,* 2004).). The

saponification value put forward the use of oil in production of liquid soap, shampoos and lather shaving creams (Oderinde *et al.,* 2009).

The present study was conducted to determine the repellent activity of the extracted oil from orange and grape peels. The visual appearance of the repellent cream was pale yellow with acceptable odour. The spreadability of the two extract orange and grape was 10 secs because it has an easily spreadable property. The pH of the two extract ranged from 6.8-7.0 which is an indication of a neutral product. The irritancy test of the two extract was performed and there were no sign of redness and itching in area applied on some bear portion of the human body (hand, legs and face). The two cream made from the extracted oil were thermally stable at $45^0c\pm 1^0c$ and no phase separation was observed after 72 hours.

Generally, it was observed that repellent cream made from the extract of grape and orange peels showed a long lasting repellent effect up to 6 hours. Candles were prepared with the two extracts, properties of the prepared candle evaluated is presented in Table 3, the flames of the repellent candles started to repel mosquito 68 secs after it was lit, after the lighting of the candle the smoke produced from the two extract grape and orange stopped after 60 secs similarly the extract of the two samples (orange and grape) showed long lasting repelling effects for more than 6 hours.The insecticides produced were put in an air tight container to avoid oxidation of the content. It was tested on some insects (cockroach, mosquitoes and black ants) it was found to be effective and was able to kill the insects within a space of 120 secs, this was observed with product from grape and orange while for the mixture of orange and grape 108 secs was observed and this was shorter than time observed when they were used singly, this may be due to the high content of limonene in the grape and orange fruit extracted oil used as part of the raw materials in producing the insecticides.The pleasant odour added as a fragrance in the two extracts (orange and grape) were perceived at the range of 120 secs. The extract of orange and grape show a long lasting repellent effect of more than 6 hours as shown in Table 4.

Table 1: physicochemical analysis of grape and orange oil

Parameters	**Grape peels**	**Orange peels**
Specific gravity	0.791	0.811
Refractive index	1.453	1.512
Boiling point (^{0}c)	171^0c -173^0c	177^0c -179^0c
Solubility	Insoluble (H_20)	Insoluble (H_20)
Acid value(mg KOH/ g oil)	15.33	17.3
Saponification value (mg KOH/ g oil)	190.56	180.3

Table 2: **Results of Evaluation of Repellent cream made from extract of orange and grape peels**

Parameters	Orange peels extract	Grape peels extract	Grape and orange extract
Physical Appearance	Pale yellow Colouration with Odour	Pale yellow Colouration with Odour	Pale yellow Colouration with Odour
Spreadability	< 10 Secs	< 10 Secs	< 10 Secs
Irritancy Test	Non	Non	Non
pH	7.0	7.0	7.0
Thermal stability	Stable at 45^0C +1^0C For 48 hrs.	Stable at 45^0C +1^0C For 48 hrs	Stable at 45^0C +1^0C For 48 hrs

TABLE 3: Evaluation of repellent properties of candle

Parameters	Orange	Grape	Mixture of Orange and Grape
Mosquito repellency	68 secs	68 secs	66 secs
Pleasant odour	120 secs	121 secs	120 secs
Smoke production	68 secs	66 secs	60 secs
Activity	$> 6hours$	$> 6hours$	$> 6hours$

Table 4: Evaluation of liquid repellent made

Parameters	Grape	Orange	Mixture of Orange and Grape
Mosquito Repellency	120 secs	120 secs	118 secs
Pleasant Odour	60 secs	60 secs	60 secs
Activity	$> 6\boldsymbol{hours}$	$> 6\boldsymbol{hours}$	$> 6\boldsymbol{hours}$

IV. Conclusion

In conclusion, repellents produced from citrus fruits peel have proved effective as mosquito repellents. The results showed that both orange and grape extracted oils can provide substantial protection against mosquitoes and insects bite as the of synthetic based DEET .This lasted up to 6 hours per application.

References

[1]. A Global Brief on Vector-Borne Diseases. WHO 2014. http://apps.who.int/iris/bitstream/10665/111008/1/WHO_DCO_WHD_2014.1_eng.pdf

[2]. Adeogun A.O., Adewuyi G.O., Etatuvie S… O., Fawehinmi AB., Lawal HO: Bioassay of Herbal Mosquito Repellent Formulated from the Essential Oil of Plants. J Nat prod 2012; 5: 109-115.

[3]. Adeniran OI., Fabiyi E. Natural products from plants as insecticides. J Nat Prod Plant Resour 2012; 2: 322-327.

[4]. Adelaja J., (2006). Evaluation of mineral constituents and physico-chemical properties of some oil seed. M.Sc industrial chemistry thesis, University of Ibadan, Ibadan.

[5]. Akinhanmi, T.F., V.N. Atasie and P.O. Akintokun, 2008. Chemical composition and physicochemical properties of cashew nut (Anacardium occidentale) oil and cashew nut shell liquid. Journal of Agriculture and Food and Environmental Science, 2(1): 1-10.

[6]. Akubugwo I., Chinyere G. and Ugbogu A., (2008). Comparative studies on oils from some common plant seeds in Nigeria. Pakistan Journal of Nutrition, 7: 570-573.

[7]. Babatunde, O. and Bello, G. (2016). Comparative assessment of some physicochemical properties of groundnut and palm oils sold within Kaduna Metropolis, Nigeria. Journal of Applied Chemistry, 9 (11): 26-30

[8]. Barkatullah M., Abdur-Rauf E. and Inyat-Ur-Rahman S. (2012). Physicochemical characterization of essential and fixed oils of Skimmia laureola and Zanthoxylum armatum. Middle-East Journal of Medicinal Plants Research, 1(3): 51-58.

[9]. Barassa SS, Ndiege 10,Lwande W, Hassanali A.(2002).Repellent activities of stereoisomers of p-menthane-3,8-diols against Anopheles gambiae (Diptera;Culicidae) Journal of medical Entomology. 39;736-741.

[10]. Barnard DR, XUe RD. (2004) laboratory evaluation of mosquito repellent against Aedes albopictuss, culex nigripalpus and ochierotatus triseriatus (Dipters: culicidae) journal of medical entomology 41: 729-730.

[11]. Bernier UR, Furman KD, Kline DL, Allan SA, Barnard DR (2005). Comparison of contact and spatial repellency of catnip oil and N,N-Diethyl 3-methyl benzamide (DEET) Against mosquitoes journal of Medical Entomology 42 : 306-311.

[12]. Baser, K. H. (2010):"Handbook of Essential Oils: Science, Technology, and Applications".

[13]. K.Hüsnü Can Baser, Gerhard Buchbauer. ISBN 978-14200-6315-8.Universitat Wien, Austria.

[14]. Bamgboye A. and Adejumo O., (2010). Physicochemical properties of Roselle seed oil. Nutrition and Food Science, 40(2): 186-192.

[15]. Bansal A., Karthik N., Saptharishi LG., Singhi., S. Mosquito repellent liquidizer poisoning in young children in summer – What to anticipate? J Pediatr Crit Care Med 2014; 15: 187.

[16]. Brouillard, R.; Chassaing, S.; Fougerousse, A. (2003). "Why are grape/fresh wine anthocyanins so simple and why is it that red wine color lasts solong?". Phytochemistry. 64(7): 1179–1186. doi:10.1016/S0031-9422(03)00518-1. PMID 14599515.

[17]. Cases A, Valiente –Banuet A,Viveros JL, Cabellero J,Cortes L, Davila P, Lira R, Rodriquez I.(2001) Plant resources of the Tehuacan –Cuicatlan Valley, Mexico Economics Of Botany 55;129-166.

[18]. Cases A, Valiente-Banuet A, Vivenes JL, Cabellero J, cortus L, Davila P, Lira R, Rodriquez 1.(2001) plant resources of the technician-cuicatlan valley, mexico economics of botany 55: 129-166.

[19]. Carrington S., Fraser, H. C. (2003): "Grapefruit". A~Z of Barbados Heritage, Macmillan Caribbean, ISBN 0-333-92068-6, pp. 90–91. [5]. Pittman H., Davis F. (1999): "Pittman & Davis - Premium Citrus Fruit Gifts - Why Are Tangerines So Tangy?".http://pittmandavis.com, pp11-17.

[20]. Caraballo AJ. Mosquito repellent action of Neemos. J Am Mosq Control Assoc. 2000; 16:45-46.

[21]. Chaiyakunapruk N., Kongkaew C., Sakunrag I., Tawatsin. Effectiveness of citronella preparations in preventing mosquito bites: systematic review of controlled laboratory experimental studies. Tropical Med Int Health 2011; 16: 802-810.

[22]. Curtis CF, lines JD, Ijumba J, callughan A, Hill N, Karimzad MA. (1987). The relative efficacay of repellents against mosquito vectors of disease. Medical vetenary entomology 16: 109-119.

[23]. Demian, M.J., (1990). Principles of food chemistry. Van Nostrond Reinhold International Company Limited, London, England2nd Ed., Page 37-38.

[24]. Denniston, K., Topping J. and Caret R., (2004). General, organic and biochemistry, 4th Ed. McGraw Hill Companies, New York, Page 432-433.

[25]. Enayati A., Garner P., Hemingway J. Electronic mosquito repellents for preventing mosquito bites and malaria infection. The Cochrane Library 2012; 4: 5.

[26]. Fashola C. O., Gloria M. M., Rubria E. R., Jose E.B., Jose L.N., Hugo J., (2016):"Characterization of volatile compounds in the Essential oil of sweet lime".Chilean journal of Agricultural research 72(2), Pg 275.

[27]. Gupta A., Oswal RJ., Patel EK. A Review On: Mosquito Repellent Methods Int J Pharm Chem Biol Sci 2012; 2: 310-317.

[28]. Goldstein BD., Hashim JH., Hashim Z., Jalaludin J., Liu W., et al. Mosquito coil emissions and health implications. J Environ Health Perspect 2003; 111: 1454-1460.

[29]. Hognadottir A., Russell R. I. (2003):"Identification of aroma active compounds in orange essence oil using gas chromatography-olafactometry and gas chromatography-mass spectrometry"J. Chromatogr., 998: 201-211.

[30]. Indian Journal of Science. 2012, 1:1. 2. Prasanna NY, Babasaheb V. Chikungunya Outbreaks in India, 2006.

[31]. Javed S., Javaid A., Nawaz S., Saeed M. K., Mahmood Z., Siddiqui S. Z., Ahmad R. (2014):"Phytochemistry, GC-MS Analysis, Antioxidant and Antimicrobial Potential of Essential Oil from Five Citrus Species", Journal of Agricultural Science; Vol. 6, No. 3, pp201-208.

[32]. Kamal G. M.,Anwar F., Hussain A. I., Sarri N., Ashraf M. Y. (2011):"Yield and chemical composition of Citrus essential oils as affected by drying pretreatment of peels", International Food Research Journal 18(4), pp1275-1282.

[33]. Liu WK, Zhany, J,Hasim J.H, Jalaludin J, Hasim Z, GOLD stein B.D. (2003). Mosquito coil emission and health implication environmental health prospect. 12:34-48

[34]. Maria C.C., Rubria E. R., Jose E.B., Gloria M. M., Jose L.N., Hugo J., (2012):"Characterization of volatile compounds in the Essential oil of sweet lime".Chilean journal of Agricultural research 72(2), Pg 275.

[35]. Moore S J, Darling ST,Sihuincha M, Padilla N, Devine GJ.(2007) A Low-cost repellents for malaria vectors in the Americas; results of two field trials in Guatemela and Peru. Journal of American Mosquitoes Control Association 6;101.

[36]. Muller GC, Junnila A, Kravanchenko VD, Revay EE, Butler J, Schlein Y, (2008). Indoor protection against mosquito sand fly bites : a comparison between citronella, linalool, and geraniol candle. Journal of American Mosquitoes Control Association. 24 : 150-153.

[37]. Makhaik M., Naik SN., Tewary DK. Evaluation of anti-mosquito properties of essential oils. J Sci Ind Res 2005; 64: 129-133.

[38]. Mohomed AA., Tarek IAAM., Zarrag IAA. Larvicidal and repellent effect of some Tribulus terrestris L., (Zygophyllaceae) extracts against the dengue fever mosquito, Aedes aegypti (Diptera: Culicidae). J Saudi Soc 2012; 20: 13-16.

[39]. Mahmud S., Saleem M., Siddique S., Ahmed R., Khanum R., Perveen Z. (2009):"Volatile components, antioxidant and antimicrobial activity of Citrus acida var. sour lime peel oil", Journal of Saudi Chemical Society 13, pp195–198.

[40]. Neeraj Dhingra, Prabhat Jha, Vinod Sharma P, Alan A Cohen, Raju Jotkar M, Peter Rodriguez S et al. Adult and child malaria mortality in India, Lancet. 2010; 376(9754):1768-1774.

[41]. Oderinde R., Ajay A. and Adewuyi A., (2009). Characterization of seed and seed oil of Hura crepitans and the kinetics of degradation of the oil during heating. Electronic Journal of Environmental and Food Chemistry, 8(3): 201-208.

[42]. Olagunju E. (2013). Extraction and Characterization of Vegetable Oil from Mango seed, Mangifera indica. IOSR Journal of Applied Chemistry (IOSR-JAC), 5(3): 6-8.

[43]. Orange essential oil (sweet) information http://www.essentialoils.co.za/essentialoils/orange.html

[44]. Patel EK, Gupta A, Oswal RJ. A review on: Mosquito repellent method, IJPCBS. 2012; 2(3):310-317.

[45]. Pandey DM., Rani N., Vidyarthi AS., Wany A. Study of Citronella leaf based herbal mosquito repellents using natural binders. Curr Res Microb Biotechnol 2013; 1: 98-103.

[46]. Sanjay RM. Antibacterial treatment on cotton fabric with neem oil, aloe Vera and Tulasi. International Journal of Advance Research in Science and Engineering. 2013; 2(7):2319-8354(E). http://www.ijarse.com IJARSE.

[47]. Sharma RS, Joshi PL, Tiwari RK, Singh GK. Outbreak of dengue in national capital territory of Delhi India during 2003. Journal of Vector Ecology. 2004; 13:337-338.

[48]. Singh N, Mishra AK, Saxena A. Use of neem cream as a mosquito repellent in tribal areas of central India. Indian J Malariol. 1996; 33:99-102.

[49]. Singh SK, Sharma HC, Singh SP. In vitro polyembryony in monoembryonic mango cultivars (Mangifera indica L.). In: Kapoor AC, editor. Sustainability of Hill Agriculture: Emerging Trends and Possible Solutions; 2002. p. 295–9.

[50]. Sharma VP, Ansari MA, Razdan RK. Mosquito repellent action of neem (Azadirachta indica) oil. J Am Mosq Control Assoc. 1993; 9:359-360.

[51]. Trongtokit Y, Rongsriyam Y, Komalamisra N, Apiwathnasorn C. Comparative repellency of 38 essential oils against mosquito bites. Phytother Res. 2005; 19:303- 309.

[52]. Vatsala R. Text book of clothing and Textiles 2nd ed. Indian council of Agriculture research New Delhi, 2003.

[53]. Walker, A. R.; Lee, E.; Bogs, J.; McDavid, D. A. J.; Thomas, M. R.; Robinson, S. P. (2007)."White grapes arose through the utation of two similar and adjacent regulatory genes". The Plant Journal. 49 (5): 772 785. doi:10.1111/j. 1365313X.2006.02997.x. PMID17316172.

[54]. Waterhouse, A. L. (2002). "Wine phenolics". Annals of the New York Academy of Sciences. 957: 21 36. Bibcode:2002NYASA.957...21W. doi:10.1111/j.1749- 6632.2002.tb02903.x. PMID 12074959.

Adepoju, M.A, et. al. "Comparism of Repellent Produced From Grape and Orange Peels." *IOSR Journal of Applied Chemistry (IOSR-JAC),* 14(8), (2021): pp 15-20