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Evaluation on the Use of Synthetic Essential Oils as Perfumery Diluent in Yenagoa, Bayelsa State, Nigeria

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ABSTRACT: Essential Oils (EOs) is responsible for their essence or odor, however, the natural composition of the product has been long defeated with the introduction of synthetic products to gag the inequality in demand and supply chain. Hence, the objective of this paper was to evaluate the Use of Synthetic Essential Oils as Perfumery Diluent in Yenagoa, Bayelsa State, Nigeria using appropriate standard methods. Data obtained show that among heavy users of diluted (synthetic) essential oil is female (63%) as against the male (37%) counterparts. The three tires age ranking in this study revealed that 51% of the total users fall within the age bracket of 15-25 years, 26-50 years (38%) and only 51-70 years (11%). Due to time spent and complicated body beauty care processes female salon (65%) consume more EOs than men salon (35%); exposing them more to the danger of synthetic essential oils. The study revealed that synthetic essential oils are dangerous to human health, therefore, it is a wake-up call for caution in the used of synthetic essential oil to avert inherent self-inflicting health challenges. Cutting the supply chain by enforcing criminal laws against illegal Essential Oils business actors is a way forward to correct this menace.

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Essential oil (EOs) is a concentrated hydrophobic liquid containing volatile chemical compounds from plants, which are responsible for their essence or odor (Wikipedia, 2024; Sattayakhom, *et al.,* 2023). Essential oils commonly include components derived from two biosynthetic groups: terpenes (monoterpenes, sesquiterpenes and their derivatives) and phenylpropanoids (aromatic ring with a propene tail) (Sadgrove, *et al.,* 2022). EOs can extract from different parts of plants (plant oil sacs or oil glands) including their leaves, barks, flowers, buds, seeds and peels. Essential oils (EOs) and their derivatives has gained popularity globally especially in the field aromatherapy, personal care and household products (PCHPs). Cumulative studies shown that essential oils help boost mood, improve job performance, improve skincare, insect repellants, reduced stress and increased attentiveness (Fairbrother, *et al.,* 2016). Improve sleep, kill bacteria, funguses and viruses, reduce anxiety and pain, reduce inflammation, reduce nausea, relieve headaches in skin (Rochlani *et al.,* 2017); reduce neuralgia, digestive disorders, treat

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stretch marks, preparation for childbirth, treatment of cancer, diabetes, hypertension, dyslipidemia, microbial infections and aid increasing breast milk production (Osaili *et al.,* 2023).

The EOs retains the natural smell by using a unique composition of chemicals, such as alcohols, aldehydes, esters, ethers, ketones, phenols and terpenes which are highly concentrated to emit volatile organic compounds (VOCs) (Sadgrove *et al.,* 2022). VOCs, in the form of compressed aerosols are propellants of personal care and household products (PCHPs) like air fresheners, colognes, and perfumes, body and hair sprays, cleaners, among others; accounted for astonished global emissions of over one teragram (1 Tg) per year of emission in 2018 and could surpass 2 Tg per year in 2050. Representing a negative impact on the atmosphere and human health (Yeoman and Lewis, 2021; Wenjuan *et al.,* 2022). The increasing concentration of fragrances and fragranced-associated VOCs in the indoor and outdoor air is an emerging pollutant causing adverse cutaneous, respiratory and systemic effects such as acute and chronic pathological conditions, mucosal irritation, and dermatitis (Clausen, *et al.,* 2020; Rádis-Baptista, 2023). Allergic reactions and neurotoxicity (Pinkas, *et al.,* 2017; de Groot, 2020); endocrine disruption in adolescences (Fouyet, *et al.,* 2020; Ramsey *et al.,* 2020); increased heart rate and blood pressure (Lee *et al.,* 2022); reproductive and sexual abnormalities (Gupta and Gupta, 2017; Martín-Pozo, *et al.,* 2021; Dosoky and Setzer, 2021). Skin and airway hypersensitivity, breast cancer and polycystic ovary syndrome, gynecomastia, liver and thyroid toxicity, reproductive problems, and teratogenic toxicity effects (Patel, 2017); autoimmune diseases (Ogbodo *et al.,* 2022); risk of cardiovascular health hazards (Kim *et al.,* 2015) etc. This is because the design, chemical synthesis, and their use in the modern fragrance (and flavor) industry comprise the content of artificial synthetic fragrances that mimic natural ones. Currently, essential oils are subject to adulterations using synthetic fragrances as perfumery diluent but with an exaggeration claims of been 'natural' or 'pure' or '100% natural', thus, demanding absolute carefulness on the end users. Synthetic fragrances include derivatives of several chemical structures and organic functions that can, individually or in combination, elicit adverse effects on biological systems and human health (Steinemann, 2016) such that it warrant careful consideration. Scientific research on the efficacy and safety of essential oils for specific health conditions is limited and more evidence is needed particularly in this trying time were young school leavers and entrepreneur usurp the production and distribution spheres in Nigeria with the economic motive to explore short-cuts in supply through synthesis or bioreactor, or using counterfeits or adulterants. The present study aims to consider and call attention to odorant VOCs, particularly synthetic fragrances, and associated formula components of PCHPs that potentially affect indoor and outdoor air quality with a negative effect on human health. This study document personal and group life experience about the seamless use of essential oil in Yenagoa city with a challenges of counterfeiting the addition of synthetic raw materials but with an excessive labeling claim.

MATERIAL AND METHOD

Study Area: The study is conducted within the Yenagoa metropolis (i.e. within the 15km radius). Yenagoa, is an industrially developing capital city of Bayelsa State, Nigeria that lies between latitude 4055'N and 4057'N and longitudes 6015'E and 6018'E in the coastal area of Nigeria; covering an area of about 706km with an estimated population of 524,400 persons (Wikipedia, 2022). *Study Design:* The study adopted a cross-sectional survey design using field observations, focus group discussions and administration of schedules. The schedules were randomly distributed among purposively selected four subgroups of two indices each such as institutional (students and staffs of the Faculty of Law, NDU, Ovom and Bayelsa Medical University, Amarata); Market (Opolo and Kpansia); Transportation (Keke tricycle and BTC users), Business enterprises (Female hairdressing and male hair barbing salon). More details about the use of schedules as documented in Ebuete *et al.* (2021). The selection of 240 respondents and administration within the Capital City using well-structured schedules, with a sample size of 60 each was to comprehensively cover the study area by ensuring major stakeholders and heavy users of essential oil is represented and analyze for three key concepts such as bio data, usefulness and effects. Others secondary data is on document searches from scientific literature, medical journals, chemical abstracts, US Patents, essential oil and Volatiles Organic Compounds abstracts and scientific reports from in vivo and in vitro. The notion of age and sex was introduce into EOs using categories such as frequency/regularity and application part relate with the factors influencing EOs uses; while economic cost, discomfort, allergies and psychological attributes relates with the effect of EOs as to guide the objective of the study.

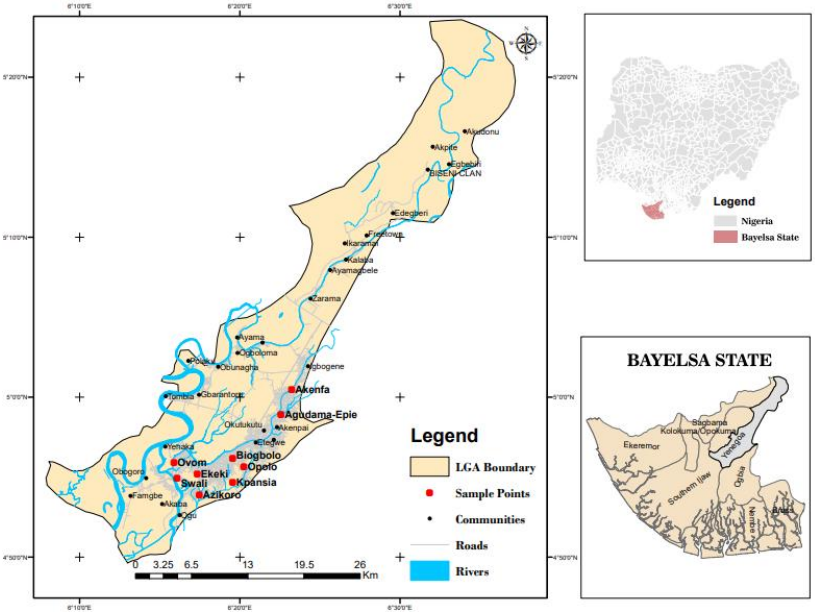

Fig.1: Map of Yenagoa Metropolis showing samples site

RESULTS AND DISCUSSION

Sex: The concept of sex was as introduced in this study to determine gender composition of EOs users. Report from this study show that among heavy users of diluted (synthetic) essential oil in the study area are female which accounted for 63% as against the male (37%) counterparts. It is not surprising that barely every two (2) in six (6) female fold goes around with a pack or a bottle of essential oil in her bag that are surrounded by some factors. In one opinion, EOs in women, either aromatherapy or hand massage is associated with a reduction in anxiety levels while in men, anxiety levels were decreased after aromatherapy, as well as after hand massage; similarly reported by Nakajima, *et al.* (2024). Another factor that influences gender variation in the used of EOs is in the odors' subjective intensity and emotional perception ratings among females (Chen, *et al.*, 2022). Body odor also known as bacteria that in turned produces enzymes; that produces an oniony smell in women and cheesy smell in men (OSS, 2017); this perspiring disparities often influence gender disparities in the demand and used of Eos that causes bromchidrosis, osmidrosis, or ozochrotia (Pfabigan *et al.*, 2022). The gender difference in olfactory sensitivity in relation to concentrations of plasma adiponectin, an adipose-specific hormone is favoring females; hence, women have a more sensitive olfactory system than men do (Pfabigan *et al.*, 2022). Earlier report by Mazlan and Diah (2019) assert that women have stronger affinity with EOs than men do. Another factor is the economic willingness of female in spending more money on EOs as earlier echoed by Ackerman and Chopik (2020). Regarding application part, female found it a fun to apply EOs among aromatherapy accessories such as necklace, bracelet, and keychains and among aromatherapy stick or plastic stick for lasting purpose while men are more on body.

Table 1: Table showing Demographic, Institutional and Business Proportions

Parameters	**Frequency (%)**
Sex (n=240)	
Male	90 (37%)
Female	150 (63%)
Age (n=240)	
15-25	122 (51%)
26-50	92 (38%)
51-70	26 (11%)
Institutional (n=60)	
Faculty of Law, NDU	33 (55%)
Bayelsa Medical University	27 (45%)
Market (n=60)	
Opolo Market	25 (42%)
Swali Market	35 (58%)
Transportation (n=60)	
Keke Tricycles	**22 (37%)**
Bayelsa Transportation scheme (BTC)	**38 (63%)**
Business Enterprise (n=60)	**39 (65%)**
Female Hair Saloon	**21 (35%)**
Male Barbing Saloon	

Age: Ages is very important as regards to population of EOs users. The three tires age ranking in this study revealed that 51% of the total user falls within the

age bracket of 15-25 years, 38% between 26-50 years and only 11% for between 51-70 years (table 1). From the results the primary age group that participates in aromatherapy is middle-aged which mostly driven by the youthful energy, lesser financial engagement, and illusionary psychological benefits. Similarly, Xiao and Nakai (2022) reported that consumers aged 13 through 26 rank highest when it comes to heavy (fragrance) usage; wearing fragrance at least three times a week. On application part, we found out that between age 51-70years essential oils is mostly apply to their face and lower limbs while 15-25 years on their face, armpits, fabrics, neck, waist and other body parts which has negative returned on end users especially on damaging of fabrics through stains in most cases with adulterated oil perfumes. To some respondent, leaving residue on garments by higher concentration of pigments that is difficult to eliminate limited their uses space.

Institutional: Institution in this analysis, houses larger populations among heavy users of EOs. Among the higher learning institutions considered is the faculty of Law, NDU (55%) and Bayelsa Medical University (BMU) had 45%, which is trace to the wide knowledge and awareness on the use of EOs among student and staffers of BMU as against NDU. Conversely, Sasmita and Suki (2015) reported that the growing awareness amongst consumers affects purchasing behavior on social conditions and affect growing interest in the source of ingredients. Secondly, the fundamental core values of the institute regarding law as a social discipline influence psychologically and encourages the uses of EOs that is not too pronounce in the health discipline except in the field of aromatherapy; thus, the sales of essential oils are correlated with consumer knowledge. In the study, few (47%) argued that EOs aid reduce anxiety, improve alertness, concentration, working memory and recall just like as reported by Ma (2022) and Witter (2020); larger populations (53%) retreated that EOs causes respiratory, skin, eye irritations, allergic and rebound headache which is similar with the report from the American Lung Association (ALA, 2024). Brown (2022) also opened that medical college-age students though sees essential oils to be safe and effective they rather find modern medical techniques (vaccines, medications) to be safer and effective.

Market: Among some heavy users and distributers of EOs is the market. Report had that Essential Oils Market Size was valued at USD 11.41 billion in 2022, and is projected to reach USD 27.82 billion by 2032, growing at a CAGR of 10.55% (Yan *et al.*, 2022).The market is a center of mixed multitudes with different ideology, believe, culture, orientations and a forward promoters of EOs productions and supply. Markets are arenas of social interaction that provide social structure and institutional order for the voluntary exchange of rights in goods and services, which allow actors to evaluate, purchase, and sell these rights (Salsabila, 2023). The supply chain of EOs in the study area is much at Swali Market (58%) while at Opolo Market accounted for 42%; which is likened to the higher numbers of synthetic EOs shops at Swali, proximity to supply and demand side, operational system. Similarly, Salsabila (2023) reported that in Indonesia, essential oil prices are influenced by world essential oil prices, resulting in the cultivation of low quality essential oil business, which is generally in the form of a small business, mostly occupied by unemployed young school leavers. Sarkic and dan Stappen (2018) added that due to the high demand for essential oils, the methods commonly used are counterfeiting the addition of synthetic raw materials but with an excessive labeling claim.

Transportation: The costs associated with transportation, storage, loading, and unloading operations increase the cost of the final product (EOs) (Timirgaleeva *et al.*, 2021). The concept of transportation in this study explained the place of drivers and owners of vehicles in the uses of EOs. The transportations company are among the major users of EOs, bearly 95% of drivers, car owner utilized EOs as deodorants to ward off unnecessary odor within, and our study revealed that Keke Nepepe Tricycle drivers accounted for 37% user while the Bayelsa State Transportation Scheme (BTC) accounted for 63% users (table 1). This is because though larger numbers of commuters and passerby prefer boarding Tricycle to bus and cars in the day for the sake of ventilations, easy accessibility, user friendly, swift and lower cost within the study area, the proportion of EOs users and effect is more in Cars and buses due to its close units. In general, some commuters frown over the excessive used of EOs by Tricycles and Cars drivers that have trigger morning sickness (motion sickness), allergies and asthma symptoms in a way of promoting neural issues like dizziness, seizures, headache and insomnia in both short and long distance travelling. Similarly, Pinkas *et al.* (2017) reported that experiencing neural issues like dizziness, headache and insomnia resulting from the exposure of Phthalates, synthetic musk's, and terpenes from synthetic EOs.

Business Enterprise: Business Enterprise in the concept of this study represent such organizations as

sole enterprises engaging with the use of EOs, off such enterprise is the female and male salon. Salons and its operation consume EOs on a daily basis as customers and patrons often require the applications EOs each time of services. The study revealed that female salon consume more of the EOs that accounted for about 65% as against 35% for the male counterparts (table1). Female spent more time, hence they consume more and are exposed to EOs during body maintenance and daily self-care routine which may likely lead to excessive used that may cause damage of hair follicles, causing hair loss instead of hair growth, causes skin irritations and allergies as mostly observed by respondent. Similarly, Uronnachi (2022) attributed headaches, migraine, insomnia, emotional upset and depression observed by most female after visiting saloon to the excessive used of EOs. Contact dermatitis like burning, discomfort, or painful tingling, discoloration in the affected area, allergic reactions, skin rashes like itchy and runny nose, difficulty breathing are other side effects of EOs received by salon clients according to VitalSkin Dermatology (2023). Fouyet *et al.* (2019) also opined that Pregnant women exposed to chlorpyrifos through essential oils (EOs), resulting in adverse effects to the mother and fetus as it interfere with placental function and induce placental toxicity. In adolescents and female children, some components in EOs particularly of Lavender oil have demonstrated estrogenic and antiandrogen activities that influencing hormone leading to abnormal breast development in children Osaili *et al.* (2023). Lucaccioni *et al.* (2020) reported that the associated endocrine disruption with EOs potentially induced pre-pubertal gynecomastia and premature thelarche resulting into premature breast development in adolescents. However, despite of the above, at control moderate rate, which is sternly unachievable, Abelan *et al.* (2022) reported that some EOs promote hair growth, stimulating sebum production that aid improved scalp health, reduce stress levels while RHTC (2018) added reduce hair loss, stress reduction, calming, aid sleep to moderate uses of EOs.

Conclusion: Essential oil (EOs) is a concentrated hydrophobic liquid extracted from plant parts containing volatile chemical compounds that are responsible for their essence or odor. The natural composition of the product has been long defeated with the introduction of synthetic products to gag the inequality in demand and supply chain. These synthetic fragrances which include derivatives of several chemical structures and organic functions that may comprise complex mixtures of dozen to hundreds of chemicals instead of a single odorant compound is potentially harmful to human health and the environment. Psychologically, ardent and heavy reliance users of EOs experienced mood swing, poor job performance and increase stress when EOs product is temporarily out of reach. Conclusively, Essential oils belong to a group of substances that are very often subject to adulteration because the price of natural oil is always higher than synthetic oil but with an exaggerated claims labeled as "pure", "natural" or "100% natural" which call for caution and product awareness on the part of consumer to avert inherent self-inflicting health challenges.

Declaration of Conflict of Interest: The authors declare no conflict of interest.

Data Availability Statement: Data are available upon request from the first author or corresponding author or any other authors.

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