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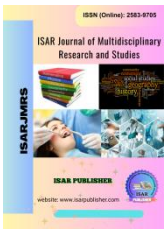

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Original Research Article

Aromatherapy of *Frankincense dalzielii* pyrolysis: Historical and its efficacy on Tail cuff's cardiac quantification in acute high fat-fed rats

Tope I. Fasan[1, 2*], Olubukola S. Olorunnisola[1], Jibayo P. Akinbosola[2] and Abimbola Theresa Ola-Adedoyin[2], Kayode Olaoluwa Olaniyan[2, 3]

[1]Department of Biochemistry, Ladoke Akintola University of Technology, Ogbomosho, Oyo state, Nigeria.

[2]Product Development department, Nigeria Natural Medicine Development Agency, Federal Ministry of Science, Technology and Innovation, Lagos, Nigeria.

[3]Veterinary Parasitology and Entomology Department, Federal University of Agriculture, Abeokuta.

***Corresponding Author**
Tope I. Fasan

Department of Biochemistry, Ladoke Akintola University of Technology, Ogbomosho, Oyo state, Nigeria

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Abstract: According to my inherited custom, the dried West African *Frankincense dalzielii* undergo pyrolysis in a charcoal burner during religious services, actively undergoing metabolites' sublimation and the members eventually inhaled the resultant but major essential effluent smoke, and to date, the health benefits of the incense fragrance haven't been evaluated up till now, as traditionally used by our religious forefathers. The principle, "Let food be thy medicine, and medicine be thy food", advocated by Hippocrates (460–377 BC), the father of modern medicine is very germane. Hence, I thus investigated the beneficial role of *B. dalzielii* frankincense and myrrh smoke as it's usually applied during worship in most Catholic, Orthodox, Anglican, Taoist, and Buddhist Chinese religious centers, and as it perhaps modulates the adiposity, cardiac rate, systolic and diastolic values of high fat fed Wistar male rats, within an acute duration of 60days using Tail cuff measuring device. Rats (n =21) were used in this study and equally divided into three groups, within which the third group fed high-fat chow were exposed to 30g of *B. dalzielii* frankincense and myrrh smoke for one hour, emanating from incense-charcoal burner twice daily, morning and night for 60 days. During the period, weights of all the rodents were measured, noted twice a week, and at exactly 24 hours after the last exposure, cardiac rate, systolic and diastolic values were quantified using a Tail cuff device at the Faculty of Veterinary Medicine, University of Ibadan. Group 2 assaulted with the high fat diet (HFD) only, revealed a significant increase in adiposity, blood pressure, and heartbeat, while group 3 co-exposed to the smoke of *B. dalzielii* resources with the HFD showed a significant reduction in the latter to near normal group. More so, agility and active responses in the co-treated group were of imminent accomplishment. This investigation demonstrated that *B. dalzielii* smoke could attenuate high fat diet triggered adiposity, positive inotropism, and high heart pressure.

Keywords: *B. dalzielii*, pyrolysis, incense smoke, blood pressure, cardiac rate, adiposity.

INTRODUCTION

Aromatherapy is the therapeutic application of volatile and aromatic essential oils from medicinal plants to treat human pathologies for ages past. It is of great relationship with herbal medicine says a French chemist named Rene´-Maurice Gattefosse´, who authored a book of the same study in 1937; while the variation is just the consideration of volatile biomolecules as therapeutic agents in the former. He is considered the father of modern aroma-therapeutic medicine. The aromatic plant metabolites are also commonly used in the preservation of the body's corpse afterlife as accounted by the Egyptians in 1922 (Stevensen, 1998). Aromatic metabolites, extracted also from the plant are also used as flavorants in beverages (J. Kohoude et al., 2016) and established to improve physical, mental, and emotional health. The application has been practiced historically and worldwide by our forefathers, nurses, and supported by the Federal Nursing Council in Brazil (Tillett & Ames, 2010). Several ailments including fever, malaria, respiratory-related dysfunction, system asthma, cold, and hypertension have also been treated by our forefathers and progeny usually by burning *B. dalzielii* frankincense. The plants are also applied in different forms such as concoctions, infusions, teas,

tinctures, or as component mixtures in porridges and soups administered in different ways, either by oral, nasal (smoking or snuffing), topical (lotions, oils or creams), or bathing.

Traditional medicine dates back to many centuries and as early as 1500 BC (Kris Hirst, 2021), but during the exploitation time, man has identified the therapeutic efficacies of a very broad range of plants. Globally, the use and research of natural therapies to treat and manage various diseases is rising. Despite historical-religion and cultural belief of *Boswellia diazeilii* as incense for centuries (Agbogidi, 2010), the plant has not been thoroughly evaluated scientifically, with gaps still existing between the indigenous ways of application during worship, knowledge, uses, and the reported accounts available.

Frankincense and myrrh are two plant products from *Boswellia* species and genera. Frankincense is a hardwood of the stem bark, while the gelatinous resin tagged myrrh is exuded from the trunk incisions of the tree. *Boswellia dalzielii* or other species in the genus *Boswellia* of the family Burseraceae, mainly from Ethiopia, Somalia, Africa, and India. Frankincense and myrrh in combination are noted to potentiate superior healing efficacy on ulcers when compared to orthodox triamcinolone acetonide drug (Cao et al., 2019). Though some researchers had investigated the therapeutic potential of the *B. diazeilii* plant with the ethanolic extract's lethal dose below 5000mg/kg/body weight (Vedekoi et al., 2019), its incense smoke on rodents using a smoke chamber (Ahmed et al., 2013) and the efficacy of its fragrance (Warrenburg, 2005), stem bark and root on heart rate and blood pressure (Abdulrahman et al., 2022), however, the tone of long-aged indigenous and cultural diligence as used in religions has not been considered.

Myrrh and its cousin frankincense are known till today, if at all, through the scriptural account of the wise men. In the saint book of Matthew, it's written that three Magi followed the Star from Bethlehem to the birth of Jesus and gave him three gifts: gold, frankincense, and myrrh (Mayer, 2008). But Douglas Daly, an originator at the New York Botanical Garden and an expert in the frankincense and myrrh study, says the duo has a rich history far outside the tentacle of the single Bible passage, and, despite a century of use and study, they're still yielding new insights to this day. The present prestige stands at burning both the *Boswellia* resin and stem wood (myrrh and frankincense approximately with a proximate of 20:80) in a charcoal burner during worship and in the free air (T.-C. Lin et al., 2008). This comprehensive investigation of the long-used *Boswellia dalzielii* plant, which grows up to 13 m in height and involved synergistic burning of both myrrh and frankincense is thus paramount. When orally comparing the two fragrance, frankincense is accounted to be sweeter while myrrh is more bitter (Harlem, 2021). The undertone in this study involves the applicable principle by which our indigenous forefathers, their progeny, and most orthodox churches over many years in Nigeria, use and burn the incense during worship and spiritual rendition. The folkloric application of smoke also includes fumigant (T. Alemika, 2006) and deodorant (Kafuti et al., 2018), while the decoction is mostly used in the management of human challenges such as tuberculosis, nervous disorders (Ezugworie et al., 2021), postpartum depression, low libido (Ezugworie et al., 2021), madness, restlessness, sleepwalking (Hussain et al., 2022), malaria fever, excessive body weight (Ahmed et al., 2013), throat infections, syphilis, asthmatic attacks, leprosy and in Niger as oxytocic agents (T. Alemika, 2006). The Islamic philosopher Ibn Sina (or Avicenna, 980-1037 AD) is also known to prescribe it for tumors (Ni et al., 2012) and ulcers (Ezugworie et al., 2021). The *Boswellia dalzielii* frankincense and myrrh which consists of the stem and resin was indigenously known as "Ararrabi", "Basamu" or "Hanu by the Hausas and Soma by the indigenous people in Adamawa State, Nigeria (Massei et al., 2023), but very well available in the northwestern Nigeria, especially in a harsh desert area, where the leaves of *B. dalzielii* are locally used to protect millet, maize, and sorghum against weevil attacks (Ezugworie et al., 2021). Economically, it's majorly transported by spiritual and traditional traders to southwestern regions of Nigeria for sales revenue (DeCarlo et al., 2019).

B. dalzielii stem and leaves are recorded to exhibit hepato-protective, antiarthritic, analgesic, antidiarrheal (Tegasne et al., 2020) and anti-inflammatory activities in rats (T. Alemika, 2006) while both frankincense and myrrh (fm) are mostly dried at a temperature of about 30-35 degree celsius, and culturally burn in charcoal by traditional worshippers to incite pleasant mood (Herz, 2009). The inclusion belief of the burnt fm over ten decades also includes the ability of the nuance/smoke to reduce tension (Moussaieff et al., 2008), ease neurotic-related pathologies (Dimancea, 2021) and enhance spiritual orbit in religious rendition (Ryan Bambrick, 2016). (Gnatta et al., 2016) also figured aromatherapy among other therapeutic medicines, as the main practice in some cultural beliefs in which *B. dalzielii* application is included, while the components dominated are α-pinene, α-thujene, myrcene, p-cymene, and limonene (DeCarlo et al., 2019), which are also established at improving mental, physical, and emotional well-being. (Gnatta et al., 2011) further established the direct absorption of the fragrance smoke through the skin, inhalation by olfactory nerves, which are directly delivered with the Central Nervous System, and eventually to the blood circulation where they are assimilated by the patient tissues and organs for salubrious benefits. Other active and beneficial *Boswellia* constituents accounted are functional classes of terpenoids, comprising hydrocarbons and hydroxyl groups with an established immune-modulatory (Ahmed et al., 2013), pro-apoptotic (Moussaieff & Mechoulam, 2009), antimicrobial, antidiabetic (Yakubu et al., 2020), anticarcinogenic (Al-Yasiry & Kiczorowska, 2016), and anti-inflammatory activities (Al-Yasiry & Kiczorowska, 2016) among others (Tegasne et al., 2020). In another study, (Ezugworie et al., 2021), (M. J. Kohoude et al., 2017), (T. E. Alemika et al., 2004) and (Yakubu et al., 2020) also reported the phytochemicals to include flavonoids, alkaloid, cardiac glycoside, tannins, saponin, incensole diterpenoid, phenols, and traces of steroids. Therefore, this study thus aims to investigate the beneficial role of *B. dalzielii* frankincense and myrrh smoke as it's usually applied during worship after pyrolysis, and as it perhaps modulates weight, cardiac rate, systolic and diastolic values of high fat fed Wistar male rats within an acute duration of 60days using Tail cuff measuring device.

Dietary fats are now very common in most readymade meals, though very well relevant also in nutritional diets, natural and refined products. The World Health Organization, Dietary Reference Intakes, Food Nutrition Board, and Institute of Medicine recommended a total fat intake between 20 and 35% of total calories per adult, and a dietary rule of 20% or below of saturated fat for patients with cardiovascular disease (CVD) (Liu

et al., 2017). Nonetheless, it should also be noted that fat as a source of energy, if gluttonized also contributed to deleterious human challenges (Al-Farhaan et al., 2021), leading to excessive weight gain (Sackner-Bernstein et al., 2015), vasoconstriction (Pons et al., 2017), endothelial dysfunction (Natsis et al., 2020), cardiac-related angiotensin II and endothelin converting enzymes activation, and eventual stroke if not death (Sv et al., 2021). Others also include sudden clinical records of adiposity, atherosclerosis in animal models, dyslipidemia along the tunica intima (Muller et al., 2021), hypertension in the elderly (Doggrell & Brown, 1998), and ultimately promoting human mortality (Uemura & Mori, 2006). The high-fat rodent diet used in this study composed of 15% fat, and thus administered to the experimental rodents for 60 days, once daily (Sv et al., 2021).

Conventional non-invasive blood pressure assessment and heart rate quantification in high-fat diet-fed-conscious rodents have been studied using the tail-cuff method. The tail-cuff sensor was calmly attached to the tail of the experimental animals and allowed to habituate before reading. At least, three systolic and diastolic consecutive readings were obtained from each rat in this study, averaged, and recorded for optimal evaluation of the cardiac functionality (Kubota et al., 2006). Tunica intima flexibility plays also a crucial role in the modulation of vascular tone of the heart and blood fluidity in high-fat-assaulted animals, as it triggers the formation of plagues and adipose tissues mostly in aged animals, unbalancing the homeostasis of endothelium-derived vasodilator and vasoconstrictor indicators. Persistence in this endothelial dysfunctionality and its affiliates are known and closely related to high levels of arterial Blood pressure (BP) of the heart, and of a value equal to or greater than 140/90 in humans and 150/85 in male rats (Doggrell & Brown, 1998), apparently with a consistently high value of heart rate (Drenjančević-Perić et al., 2011). This is majorly the ethio-pathogenesis account of a shortened lifetime in humans and the most physiological cause of heart disease worldwide, most common among the black race (F.B.O. Mojiminiyi, 2012). It is also the metabolic dysfunction that could eventually lead to cardiac muscular derangement, heart attack, stroke, renal failure, hypertension, and death (He et al, 2004).

Chemical Constituents of *Boswellia frankincense*

The main active phyto-constituents of the plant are terpenoids (oleanolic, lupinane) and boswellic acid (β-boswellic acid, acetyl-β-boswellic acid, 11-keto-β-boswellic acid, 3-acetyl-11-keto-β-boswellic acid, α-boswellic acid, and acetyl-α-boswellic acid) (Kubmarawa et al., 2006), while others include macrocyclic diterpenoids, pentacyclic triterpenoids, tetracyclic triterpenoids, and a variety of essential oils (Moussaieff & Mechoulam, 2009).

While compounds such as 1,2,4a,9as -tetramethyl-1,2,3,4,4a,5,6,14b-octahydropicene, 2,9-dimethylpicene, sabinene, myrcene, α-pinene, α-thujene, α-phellandren-8-ol, limonene, incensole acetate, α-phellandrene, pentacyclotriterpenes, linalool, octyl acetate, macrocyclic diterpenes, and 1-octanol were documented in the fragrance of *Boswellia* species after pyrolysis into aqueous solvent and as accounted by (Al-Harrasi et al., 2014), (Cao et al., 2019), (Hussain et al., 2022), (Peng Ren et al., 2017), (Maronigiu et al., 2006), (Tegasne et al., 2020), (Ljaljević Grbić et al., 2018), (Basar, 2005) and (Massei et al., 2023).

MATERIALS AND METHODS

Collection, Identification, and Authentication of the Plant Material

The *Boswellia dalzielii* plant, leaves, stem, and resin were harvested fresh, sometimes in 2021 from its habitat in Gwash. II, Jos LGA, Plateau State on Lat: 9.96444, Long: 8.96288, and authenticated with Voucher number 113661 by Dr. T.K. Odewo, Herbarium unit, forestry research institute of Nigeria, Ibadan. The stem and resin were dried under a temperature of 27 - 32 degree Celsius as usually done by our traditional forerunners, before its application as frankincense and myrrh in religious services.

How to Burn the frankincense and myrrh (FM): The charcoal will be lighted with little kerosene using matches for about 15 seconds until it ignites in a burner. 30g of incense was then added to the burner to undergo pyrolysis and soon release the essential, aromatic fumigants through the smoke in the open animal house where the animals are kept. This is just a representation of how it's being used during religious worship for ages (Yadav et al., 2020).

Animal grouping

Wistar rats weighing about 160-180 g male sex were used for this experiment. The experimental rodents were obtained from the animal unit of Ladoke Akintola University of Technology, Oyo state, Nigeria. The animals were fed with standard chow once daily, with water ad libitum, and acclimatized for two weeks before the commencement of the investigation for 60 days. The study was conducted under established public health guidelines for handling experimental animals as approved by the ethical committee of the institution.

Experimental rats (n=21) were divided equally into 3 groups:

Group I was placed on the normal chow diet.

Group II fed only with HFD

Group III fed with HFD, and co-treated with FMS, twice daily.

On the 61st day, the weight, heartbeat, systolic and diastolic values of all the rodents were measured and recorded using a 5kg Mechanical Type Stainless Steel weighing balance and tail-cuff device respectively at the Faculty of Veterinary Medicine, University of Ibadan.

Statistical analysis

The quantitative results of the experiment are represented as mean±standard error mean (SEM), analyzed using GraphPad 5 software, and considered significant at $p<0.05$ under Tukey's Multiple Comparison Test.

RESULTS AND DISCUSSION

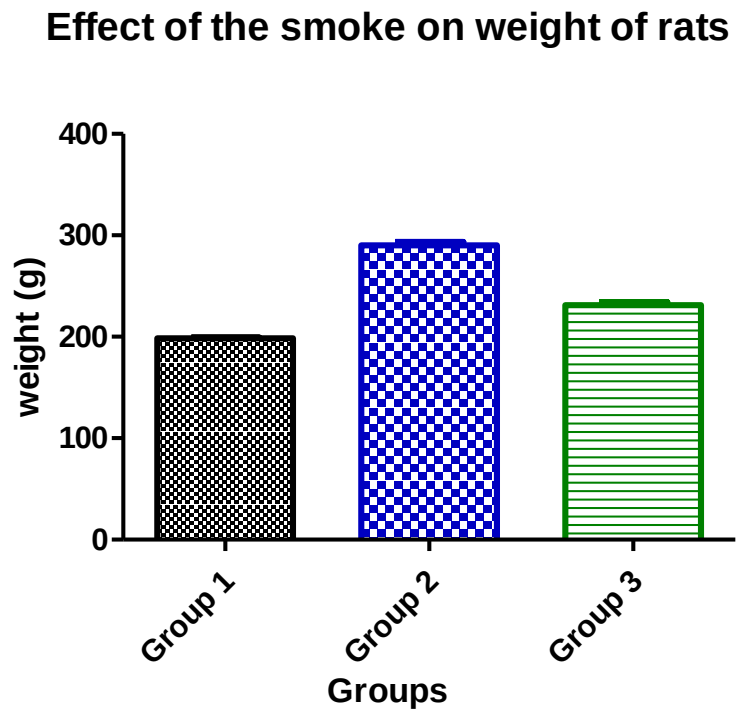

Figure 1: Effect of FMS on weight of high fat fed rats

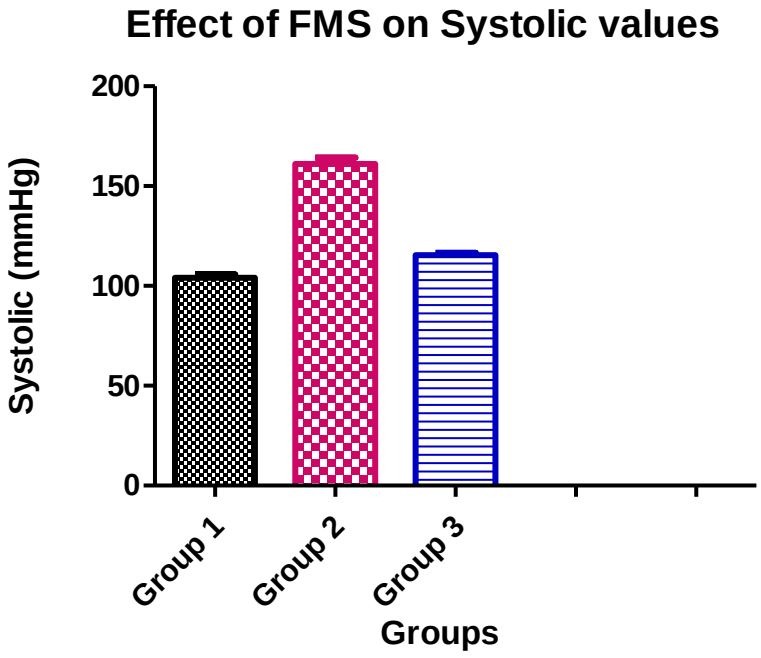

Figure 2: Effect of FMS on systolic values of high fat fed rats

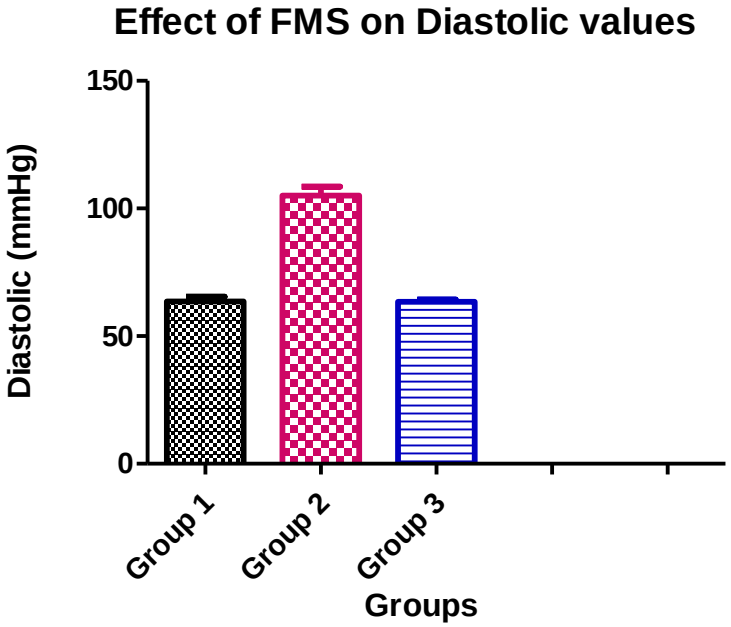

Figure 3: Effect of FMS on diastolic values of high fat fed rats

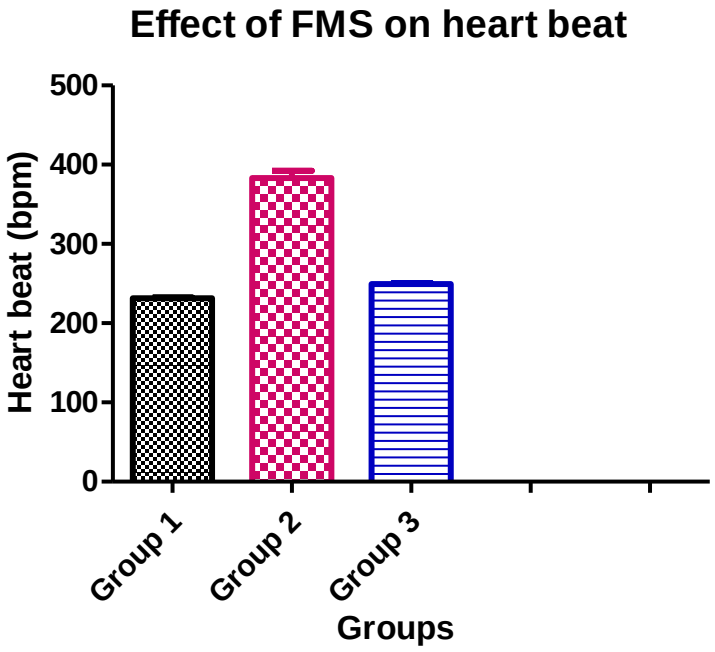

Figure 4: Effect of FMS on heart beat vaues of high fat fed rats

KEYS:

Group1 - Group fed normal rat chow.

Group2 - Group administered high fat diet (HFD).

Group3 – Group co-exposed to FMS and HFD.

Though, the group fed HFD had a significant weight increase ($p < 0.05$) after 60 days as shown in Fig 1. However, rats co-exposed to FMS and fed HFD showed a significant reduction in weight to near normal group. The peculiar weight gain of the rats fed with HFD is consistent with the previous HFD-induced obsessed rats studies as accounted by (Sackner-Bernstein et al., 2015). Nonetheless, the ameliorative effects of FMS on the weight of group co-fed with HFD, though supported by the research account of (Gomaa et al., 2019), could have been moderated by the action of α-pinene and myrcene in the gaseous products as reported by (DeCarlo et al., 2019).

Fig 2 and 3 showed that there was a significant ($p < 0.05$) percentage increase in the systolic and diastolic values of group 2 fed with HFD when compared with the group on normal chow. The observed increase is in agreement with the account of (Ozemek et al., 2018), who reported a great correlation of fat, refined

carbohydrate meals, and hypertension via disruption of endothelial tunica intima of the blood vessel. However, the third group co-treated revealed a significant ($p < 0.05$) decrease in the systolic and diastolic aftermath when compared with the normal control. The accomplished anti-hypertensive efficacy, however has a great correlation with the report of (Mahdian et al., 2020).

The result represented in Figure 4 indicates that HFD could significantly ignite ($p < 0.05$) the inotropic level of the heart in animal model when compared with the group on normal rat chow. However, co-treatment in the other group with FMS, ameliorated the outrage to near normal. The recuperation effect on the heartbeat was in agreement with the account of (DeCarlo et al., 2019), (Herz, 2009) and (Moussaieff et al., 2008) via hormonal activation of mental, physical, and emotional well-being.

Discussion

Hypertension is known worldwide as the major incidence of cardiovascular diseases, triggers sometimes by a high-fat diet leading to stroke if not death. This is very common in humans above 40 years and markedly increases till over 65 years of mismanagement, due to prognosis from endothelial atheroma, thrombosis, hemorrhage, and embolism (Doggrell & Brown, 1998). While clinical studies have demonstrated and established the effectiveness of frankincense resin in some human diseases such as neuro-disorder (Ameen et al., 2017), asthma, rheumatoid arthritis, bowel inflammation (Kim et al., 2015)., osteoarthritis (Ernst, 2008), and multiple sclerosis (Stürner et al., 2018), yet the influential impacts of the pyrolysis as used in orthodox worship centers haven't been considered. However, the aromatic essential oils and the antioxidant fumigants (Eleanor Cummins, 2021) with the active phytoconstituent terpenoids (Cao et al., 2019), traveled from the olfactory nerves directly to the brain to impact the amygdala, the emotional center of the brain thereby exhibiting its medicinal potencies. In this study, the high fat diet was established to significantly trigger positive inotropism thereby promoting cardiovascular-related hypertensive pathology and its adipocyte co-morbidities in animal models, as also established by (Engeli et al., 2003). The in-vivo etiopathogenesis of hypertensive lesions involves a series of abnormal metabolic and bio-molecular changes which can be quantified via some indicators called 'cardiac biomarkers' such as troponin I and T, myoglobin, lactate dehydrogenase, creatine kinase, and bilirubin as postulated by (Ferriero et al., 2018) and (Iqbal et al., 2012). However, the scope of this study is to investigate the possible morphological and cardiac modulatory effect of *Boswellia dalzielii* Hutch. (*Burseraceae*) stem (frankincense) and resin (myrrh) fragrant smoke (FMS) as it affects the body weight, cardiac rate, and blood pressure of high fat diet assaulted experimental rodents. Interestingly, the synergetic efficacy of frankincense and myrrh phytoconstituents have been established in a recent study by (Cao et al., 2019).

Traditional Chinese and Ayurvedic medicine applications of frankincense and myrrh had recent times established its efficacy on heart-related diseases (Cao et al., 2019) and obesity (Morikawa et al., 2017), which was also re-assured in the co-treated animal group in this study. In addition, it is of interest that FMS was able to act as freshener, fumigating the environment (Salisu et al., 2018), driving away all insects (Wei See et al., 2007), mosquitoes inclusive in the vicinity of the animal house fumed as also accounted by (Catholic University of Eastern Africa, Nairobi – Kenya & Ekanem, 2021) in which oleoresin, a volatile chemotype of *B. dalzielii* was reported in this esteem (DeCarlo et al., 2019).

The degree of atherogenicity of fatty diets, compromising body weight, hypertensive lesion, deranging tunica intima and its related bio-macromolecules (BM), through the leaky of defective renal-hepatic morphology and sub-endothelial space, have been well accounted for and to closely influenced the cardiac integrity (Natsis et al., 2020). The cytotoxic prevalence etiologised by high-fat meals had been recorded to increase the record of cardio-pathology especially in developed and developing countries, where high-fat condiments are usually consumed in their respective dishes. All these were somehow related to the final accounts in this investigation. Withal, the phytoconstituents in the smoke notably, α-pinene and myrcene (DeCarlo et al., 2019) could have been the drain behind the recuperation of the high fat diet-driven lesion, vis-à-vis adiposity, high cardiac rate, and blood pressure concisely to near normal level.

Hypertension (HTN) is one of the main causes of premature death in the world. According to the WHO, 1.13 billion people suffer from HTN and 4 in 5 hypertensive people do not have it under control. This tends to increase the risk of suffering from other diseases such as stroke, coronary heart disease, and obesity. High blood pressure can be caused by different factors including increased hypertrophy in conjunction with deranged inotropism and eventual alterations in the renin-angiotensin-aldosterone system (RAAS) components. This homeostatic modulation is essential in the regulation of blood pressure (BP), sodium-potassium balance, and fluid volume. Thus, increases in the Angiotensin-converting enzyme (ACE) levels, a key component of RAAS, induce vasoconstriction, degradation of the vasodilator bradykinin, and eventual high BP. The inhibition of this compromised blood pressure co-parameters (López-Fernández-Sobrino, Soliz-Rueda, Suárez, et al., 2021) triggered by a high-fat diet, could have been actuated by the anti-oxidative potency of volatile α-pinene, α-thujene and α-phellandren-8-ol from the FMS as postulated by (Massei et al., 2023), (Ghorbani et al., 2013) and (Feairheller et al., 2009), which thus constituted the significant reduction of systolic and diastolic levels in this cardiac tail cuff assessment using an animal model (López-Fernández-Sobrino, Soliz-Rueda, Ávila-Román, et al., 2021).

More importantly, a rising heart rate does not cause the blood pressure to increase at the same rate. Even though the heart beats more times a minute, healthy blood vessels sometimes dilate, allowing more blood to flow through. Since, it may be possible for the heart rate to double safely, while your blood pressure may respond moderately (He, MacGregor, 2003). Hence, the derangements triggered by a high-fat diet should not be considered on heart rate alone. This is pertinent as evaluated in this study. More considerably, FMS was able to reduce anxiety, blood pressure, and cardiac rate in the co-treated group to near normal as also postulated by (Karadag et al., 2017).

More so, a high fat diet was established to induce obesity in a group of rats assaulted with the chow. However, the other group co-treated with the fragrance from *Boswellia dalzielii* frankincense and myrrh (BFMS) experienced a significant decrease amidst the proliferation of adipose tissues which could have been precipitated by the activity of the terpenoids, boswellic acids, and other volatile

exogens as pronounced by (Cao et al., 2019) and (Kiecolt-Glaser et al., 2008), which was also supported by (Keyhanmehr et al., 2018), (Akinsanmi et al., 2019) and (Song & Yang, 2022) research accounts.

The medicinal *Boswellia dalzielii* frankincense and myrrh (BFM) are noted among Ethno-medicine practitioners and religious worshipers since antiquity to date. The evidence from this study suggested that smoke from BFM, as a complementary and alternative modality, can help in alleviating the anxiolytic status of patients (Gong et al., 2020) as it significantly reduced the heart rate to near normal in the co-treated rodents. The efficacy also connotes an improvement in the sleep quality of co-treated animals, which also followed suit with the record of (Abubakar et al., 2017) and (Tang et al., 2021).

The essential/ethereal oils and the main volatile constituents of *Boswellia dalzielii* (Hutch) were α-thujene, α-pinene, and α-phellandren-8-ol (Massei et al., 2023), which must have been evaporated on exposure to an ambient temperature and secreted either directly by the plant protoplasm or by the thermal decomposition of the plant glycosides (Hamuel, 2012), hence activating their radical scavenging abilities (Rodrigo et al., 2011), and eventually leveraging the anti-hypertensive efficacy recorded in the co-treated study. Considering the various complications associated with the high fat diet assaulted rodents, it was established that the smoke from the prescribed weight could be used as a proper supplemental therapy to improve the related complications by the agonist, most especially in an aerated chamber, as postulated by (Li et al., 2022) and (Hwang & Shin, 2015), perhaps precipitated by macrocyclic diterpenes and pentacyclotriterpenes, its most active phytoconstituents in the smoke (Peng Ren et al., 2017).

On the other hand, some Incense smoke were reported to sometimes contain gaseous contaminants such as carbon monoxide (CO), sulfur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (Wei See et al., 2007), which are slowly accumulated carcinogens in a poorly ventilated environment (J. M. Lin & Wang, 1994). However, this study found otherwise as it was done in a well-ventilated animal house which thus perhaps limits the hypothetical toxicological impacts of the FMS gaseous toxicants (T.-C. Lin et al., 2008). More so, (Ger et al., 1993) and (Farahani et al., 2019) also pronounced a similar beneficial association between incense burning and adenocarcinoma of the lung in an aerated environment (Yao et al., 2008) mostly potentiated by Myrrh triterpenoids (Gao et al., 2015), while (Koo et al., 1995) and epidemiologists at the Hong Kong Anti-Cancer Society, Aichi Cancer Center established: "zero correlation between exposure to incense pyrolysis and respiratory pathology such like chronic cough, chronic bronchitis, runny nose, asthma, pneumonia and allergic rhinitis.

Conclusion

In this study, the co-treated group fed with the formulated high fat diet exhibited reduced systolic and diastolic values compared with the untreated high fat diet driven hypertensive rats after 60 days. Furthermore, altered activities of inotropic rates and body hypertrophy were both restored to near-normal threshold in co-treated hypertensive rats. It could be extrapolated that high fat diet could detrimentally triggers hypertensive-related derangement, whereas FMS exhibited ameliorative potencies (Gao et al., 2015) in a concise manner, and as an anti-hypertensive agent, particularly in an aerated animal house with cross ventilation. However, the invivo and dose-dependent evaluation is also very necessary for more details in the near future. Be as it may, recuperative role and cardiac remediation in this study might have also been potentiated via the anti-oxidative and recuperative role of FM (T.-C. Lin et al., 2008) thermal pyrolysis of its incensole acetate (Hussain et al., 2022) and boswellic acids phytoconstituents in hot charcoal (Tegasne et al., 2020) at 150°C and above, resulting into another gaseous potent 1,2,4a,9-tetramethyl-1,2,3,4,4a,5,6,14b-octahydropicene, and 2,9-dimethylpicene products, emitted via dehydration, demethylation, dehydrogenation, and decarboxylation (Al-Harrasi et al., 2014). All the latter with other dominant but potent gaseous products postulated after pyrolysis in charcoal are α-pinene and myrcene which perhaps actuated the recorded efficacies (Ljaljević Grbić et al., 2018) among others (Basar, 2005). In addition, the thermal components might have also inhibited the progress of angiotensin-1-converting enzyme activity, cholinesterase, arginase, and purinergic enzymes and enhanced Nitric oxide (NO) levels (a vasodilator), known related bio-variables in hypertensive rodents as pronounced by (Oboh et al., 2022) and (Adebayo et al., 2023), thereby actualizing the potency of FMS in this study. Meanwhile, the cross-ventilated animal house designated only for the co-treated group holistically reduces the deleterious effects of other toxic gases after pyrolysis as accounted by (Wei See et al., 2007) but rather permeates a better insect-free zone than the non-frankincense environment counterpart thereby acting as a fumigant to a certain extent as also postulated by (Wei See et al., 2007), with α-pinene, α-thujene, and α-phellandren-8-ol (Massei et al., 2023), perhaps acting as the insecticides in this regard.

The findings thus exhibited the beneficial importance of FMS in a well-ventilated environment with counter-evidence when compared with the report of (Ahmed et al., 2013) on Boswellia *papyrifera* (*B. papyrifera*) and *Boswellia carterii* (*B. carterii*) smoke done in a closed chamber.

Conclusively, FBS could be considered as alternative management to alleviate the elevation of arterial blood pressure associated with a shortened life expectancy (Beg et al., 2011) and be pharmaceutically considered as a future therapeutic agent in high-fat diet-associated pathologies. Moreover, no visible side effect was noticed within the scope of this study, but have a great correlation with the report of (Majeed et al., 2019) on participants who were administered 169.33 mg of *boswellia* extract twice daily for about 17weeks. Therefore, FMS shows a promising alternative medical forethought against high fat-related agonists and its comorbidities in the quest to promote healthcare delivery.

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Conflict of interest

We wish to proclaim that there is no counter-opinion or existing conflict in this study, once the aerated environment is considered as accomplished.

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