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Phytochemical profiling of an aqueous polyherbal formulation used in traditional management of gastric ulcer

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Abstract

This article assessed the phytochemical profile of a trado-medical anti-ulcer herbal formulation consisting of *Chromolena odorata* leaf, honey from *Apies mellifera* and palm kernel oil from *Elaeis guineensis.* The polyherbal formulation was prepared using macerated aqueous extract of *C. odorata* leaf, honey and palm kernel oil combined in the ratio of 7:2:1. The phytochemical profile of the formulation was determined using gas chromatography mass spectrometry fitted ion detector. The result of the analysis showed that the most abundant phytochemicals in the formulation were kaempferol (29.60mg/L), genistein (18.22 mg/L), catechin (18.19 mg/L), arthemetin (5.25 mg/L), diadzin (4.02 mg/L) and butein (3.91 mg/L). The polyherbal formulation predominantly composed of flavonoids and phenolic compounds. These classes of phytochemicals have been characterized by their free radical scavenging, antioxidant, anti-inflammatory and anti-cancer properties. The presence of these bioactive compounds may be responsible for the therapeutic use of the formulation in traditional management of gastric ulcer.

Keywords: Antioxidants; Anti-inflammatory; Gastric ulcer; Phytochemicals; Polyherbal formulation

1. Introduction

The concept of polyherbalism has been in used in traditional medicine for centuries. Polyherbal formulations are pharmaceutical preparations that contain combination of different medicinal herbs or plant extracts. These formulations have been profoundly used in traditional Chinese medicine, Ayurveda and other indigenous healing practices for centuries (Parasuraman, Thing & Dhanaraji, 2014). Polyherbal formulations are gaining wide recognition in modern medicine as a result of their potential synergistic effects, therapeutic benefits as well as reduced side effects when compared to single herb preparations (Shikha & Supriya, 2016).

Chromolena odorata is a shrub of the Asteraccae plant family. It has various common names like Siam weed, bitter bush, French weed and it is locally known as awolowo leaf in the western part of Nigeria (Ajay et al, 2021). The arrow head-shaped leaves are 6-12cm in length and 3-7cm in width, with three veins in a pitchfork appearance. The leaves grow in opposite pairs along the stems and branches. *Chromolena ordorata* has been shown to possess anti-cancer, anti-diabetic, anti-hepatotoxic, anti-microbial and antioxidant properties (Alisi & Onyeze, 2008).

Honey from *Apies mellifera* is a sweet fluid made by honeybees using the nectar of flowering plants. There are different varieties of honey, which vary in colour, odour and flavour. Honey contains mostly sugars, amino acids, vitamins and minerals like Iron and zinc. It is also rich in health-promoting plant compounds known as polyphenols (El-shahawl et al, 2017). Honey has been used orally to treat coughs, gastro-intestinal disorder, asthma and topically to treat burns, promote wound healing and treats skin ulcers in both humans and animals (Ozcen & Aljuhaimi, 2019).

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Elaeis guineensis (oil palm), a tropical tree crop of the family of palmae, is mostly grown for its oil. Oil palms are the primary source of palm oil and palm kernel oil. Palm kernel oil is obtained from the kernel, which is one of the residues gotten after palm oil extraction. Palm kernel oil, which is rich in essential fatty acids and antioxidants, has found versatile applications in cosmetic industries as a moisturizer and skin softening agent (Chiabi et al., 2011), food industry as an antioxidant and for frying (Dijkestra, 2016), in automobile industries as a lubricant, and in soap and detergent production as an active ingredient (Pichat, 2013).

2. Materials and Methods

2.1. Plant materials

The fresh leaves of the plant *Chromolaena odorata* (Awolowo leaf) was collected from the back of School of Agriculture and Agricultural Technology (SAAT) farm, Federal University of Technology, Owerri (FUTO), Imo State, Nigeria The plant was appropriately identified by a plant taxonomist Mr. Francis Iwunze of the Department of Forestry and Wild Life Technology, FUTO with voucher and herbarium number FUTO/FWT/HERB/2025/122. Fresh local palm kernel oil from *Elaeis guineensis* was obtained from trusted vendor at Relief Market, Owerri Municipal Council, Imo State, and fresh a honey was sourced from a farm at Obinze in Owerri West Local Government Area, Imo State.

2.2. Formulation of the polyherbal drug.

One thousand gramme (g) of fresh leaves of the plant *Chromolaena odorata* was thoroughly washed and squeezed to obtain an extract of 1300mlout of which 700ml of the extracts was collected and thoroughly mixed with 200ml of honey and 100ml of local fresh palm kernel oil to obtain 1000ml (1 litre) of the polyherbal formulation (in the ratio of 7:2:1) used in the study.

2.3. Phytochemical quantification by GC-FID

The analysis of phytochemical was performed on a BUCK M910 Gas chromatography equipped with a flame ionization detector. A RESTEK 15 meter MXT-1 column (15m x 250um x 0.15um) was used. The injector temperature was 280^{o}C with splitless injection of 2ul of sample and a linear velocity of 30cms^{-1}, Helium 5.0pa.s was the carrier gas with a flow rate of 40mlmin^{-1}. The oven operated initially at 200^{0}C. It was heated to 330^{0}C at a rate of 3^{0}C min^{-1} and was kept at this temperature for 5min. the detector operated at a temperature of 320^{0}C. Phytochemicals were determined by the ratio between the area and mass of internal standard and the area of the identified phytochemicals. The concentration of the different phytochemicals was expressed in mg/L.

3. Results and Discussion

Table 1 Quantitative phytochemical composition of the polyherbal by GC-FID

Retention Time	Area	Amount (mg/L)	Phytochemical Compound
2.617	210.53412	29.60385	Kaempferol
3.055	129.44804	18.18869	Catechin
4.567	5.96399	8.29861e-1	Quercetin
6.160	7.40762	1.03277	Luteolin
6.379	37.41651	5.25322	Artemetin
6.817	4.44904	6.16466e-1	Retusin
7.282	1.61948	2.18481e-1	Ellagic acid
7.459	6.36053	8.85022e-1	Vanillic
7.630	14.59382	2.04247	Naringenin
7.884	5.53773	7.57533e-1	Apigenin
8.174	4.38176	6.05930e-1	Hesperidin
8.517	1.12811	1.49398e-1	Isorhamnetin

8.880	9.34233	1.30371	Maricetin
9.326	10.89357	1.52132	Epicatechin
9.618	1.03318	1.43352e-1	Sinapinic acid
9.742	3.83840	5.29175e-1	Daidzein
9.905	130.06775	18.21520	Genistein
10.130	5.21132	7.23918e-1	Ferulic acid
10.295	9.28244	1.29440	Apigenin
10.498	6.16782	8.56616e-1	Lunamarin
10.844	5.56674	7.72013e-1	Gallocatechin
11.168	4.50330	6.21931e-1	Reveratrol
11.477	5.26400	7.29956e-1	Tangeretein
11.769	2.89167	3.96346e-1	Epicatechin
12.046	3.14367	4.22997e-1	Naringin
12.310	3.36374	4.63402e-1	Hesperidin
12.563	2.44619	3.29624e-1	Silymarin
12.804	3.22722	4.40219e-1	Baicalin
13.038	1.87221	2.50707e-1	Tangeretin
13.263	1.57204	2.10337e-1	Nobeletin
13.483	3.23720	4.45173e-1	Myricetin
13.696	9.81964	1.36958	Isorhamnetin
13.903	17.29846	2.42417	Flavone
14.101	27.88656	3.90675	Butein
14.310	28.59438	4.01665	Daidzin

Results of the phytochemical profiling of the polyherbal formulation showed a rich presence of phytochemicals such as kaempferol, catechin, quercetin, luteolin, artemetin, retusin, ellagic acid, vanillic, naringenin, apigenin, hesperidin, isorhamnetin, maricetin, epicatechin, sinapinic acid, daidzein, genistein, ferulic acid, apigenin, lunamarin, gallocatechin, reveratrol, tangeretein, epicatechin, naringin, hesperidin, silymarin, baicalin, tangeretin, nobeletin, myricetin, isorhamnetin, flavone, butein and daidzin (Table 1).

Table 2 Phytochemical components of the polyherbal formulation and their pharmacological properties

S/N	Name of photochemical	Pharmacological properties	Reference
1	Kaempferol	Anti- cancer and neuro-protective properties	Sayed etal., 2024 Karen etal.) 2022
2	Catechin	Neuro-protective property	Karen etal.) 2022
3	Quercetin	Anti-cancer and antioxidant properties	Aghababaei & Hadidi, (2023).
4	Luteolin	Antibacterial and neuro-protective properties	(Lo, Leung, Fedrizzi, & Barker, 2021)
5	Arthemetin	Anti- malarial, antioxidant and antimicrobial properties	Kanika and Dinesh 2024

6	Naringenin	Nephro-protective and neuro-protective properties	Kanika and Dinesh 2024 vasanti etal., 2022
7	Genistein	Anti-cancer and cardiovascular protective properties	Song, Liang and Zhou 2004
8	Lunamarin	Anti-cancer and anti-estrogenic activities	(Sohrab, Hasan, & Rashid, 2002)
9	Butein	Apoptic and anti-cancer properties	(Lee, Lee, Lee, & Lee, 2025)
10	Daidzin	Anti-cancer and anti-diabetic properties	Mohammed etal, 2021

4. Discussion

Phytochemicals are secondary plant metabolites. They are biologically active chemicals naturally found in plants that exert protective or disease preventive effects. Phytochemicals, especially the polyphenolic ones like flavonoids are known for their important biological activities like protection and enhancement of the regeneration of the hepatic cells (Igwe, Nwaogu, & Ujowndu, 2007), free radical scavenging (Alisi, Asiwe, Emejulu, Ene & Nwoguikpe, 2014), anti-microbial and anti-viral activities (Pantev, Ivancheva, Staneva, & Serkedjieva, 2006), antioxidant and ulcero-protective activities (Mba, Alisi, & Ene, 2020). In this study, the phytochemical analysis of the polyherbal formulation showed the presence of some important phytochemicals.

Kaempferol, a flavonoid which was the most abundant phytochemical present in the polyherbal formulation is a natural favonol found in many plants and plant derived foods known for its antioxidant, anti-inflammatory and anti-cancer properties (Jasemi et al., 2024). It exerts its anticancer effects by reducing the resistance of cancer cells to anti-cancer drugs, apoptosis, cell cycle arrest at the G2/M phase and down regulation of epithelial mesenchymal transition related markers (Imran et al., 2019).

Catechins which are polyphenolic flavonoids were also abundant in the polyherbal formulation. Other classes of catechin which are found in the polyherbal formulation are epicatechin and gallocatechin. Catechins are known for their antioxidant and free radical scavenging potentials. Studies have shown that catechins are able to cross the blood-brain barrier and are incorporated into the brain tissue where they exert neuroprotective and anti-inflammtory functions by modulating the mitochondrial response to oxidative stress (Karen, Patricia, Almeida & Milena, 2022).

Genistein and genistin are naturally occurring isoflavones. They are a type of phytoestrogen and belong to the group of aglycons predominantly found in soya beans and other legumes. Genistein was abundantly present in the polyherbal formulation. Studies have shown that genistein possesses anticancer, antioxidant and anti-inflammatory properties and it exerts its anti-cancer effect by interfering with signally pathway (Mukund, Mukund, Sharma, Mannarapu & Alam, 2017). Genistein is either present as unconjugated aglycones (genistein) or conjugated to glucosides as genistin. As an isoflavone and a phytoestrogen, genistein has been shown to protect against cardiovascular diseases and decreases the incidence of certain types of cancer especially breast cancer (Song, Liang & Zhou, 2014). However, due to the structural similarity between soy genistein and oestrogen, genistein often displaces oestrogen from cellular receptors thereby blocking their hormonal activity (Sharifi-Rad et al., 2021).

Arthemetin is a natural compound which exhibits various biological effects that include anti-malarial, antioxidant, anti-apoptotic, antimicrobial, anti-inflammatory and hepatoprotective effects (Patel & Patel, 2024). Arthemetin, a polymethoxylated flavone, was also present in the polyherbal formulation. It has been found to prevent oxidative degradation of cholesterol and other fatty acids by significantly reducing the viability and modulated lipid profile in cancer cells at the dose range of 10-50µm after incubation for 72 hours (Rosa, Isola, Pollastro & Nieddu, 2021).

Daidzein is an isoflavone which possess extensive nutritional value and is majorly extracted from soy and other legumes. It is a phytoestrogen and an unconjugated aglycone which has been shown to possess anticancer, antioxidant, anti-inflammatory, anti-diabetic and neurodenerative protecting effects (Islam et al., 2025). Daidzein was sparingly present in the polyherbal formulation in its unconjugated form (Diadzein) but abundantly present in the same polyherbal formulation as a conjugated glycoside (Daidzin). Daidzins which are the glycones (conjugated) has been shown to be effective in the treatment of alcohol dependency (Rezvani, Overstreet, Perfumi & Massi, 2003).

Naringin and naringenin are dihydroxyflavonones, a type of flavonoid commonly found in citrus fruits. They are known for their antioxidant, anti-inflammatory, nephro-protective and neuroprotective activities (Suvarna, Bore, Bhawar & Mallya, 2022). Naringenin was present in the polyherbal formulation. Naringin is a disaccharide derivative of naringenin

at position seven (7) through a glyosidic linkage. Naringin has been found to significantly reduce intestinal inflammation symptoms by reducing the release of inflammatory factors and increasing the expression of tight junction proteins in colon tissues (Xue et al., 2023).

Phytochemicals have been recently utilized as protective and disease preventing tool against diverse degenerative diseases linked to oxidative stress (Park, 2023). Due to their roles as antioxidants and free radical scavengers, phytochemicals form protective shield around cells and tissues, defending them against the harmful effects of free radicals, thus are known to exhibit anti-inflammatory, anti-cancer, anti-microbial, antioxidant and cholesterol lowering properties (Yang & Ling 2024).

5. Conclusion

The Polyherbal formulation was found to be rich in phytochemicals like keampferol, catechins, daidzein, naringin and epicatechin which have been proven to possess antioxidant, anti-cancer, anti-inflammatory and anti-diabetic properties. These bioactive chompounds of pharmacological importance when harnessed could be utilized in the management of some disease conditions as well as other industrial applications.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Agboola, J. B., Abubakre, O. K., Mudiare, E., Adeyemi, M. B., & Hassan, S. B. (2015). Physicochemical characteristics and fatty acids composition of some selected Nigerian vegetable oils for quenching medium. British Journal of Applied Science & Technology, 8(3), 246-253. https://doi.org/10.9734/BJAST/2015/16177

[2] Aghababaei, F., & Hadidi, M. (2023). Recent Advances in Potential Health Benefits of Quercetin. Pharmaceuticals (Basel, Switzerland), 16(7), 1020. https://doi.org/10.3390/ph16071020

[3] Ajay, A., Kumar, R. M., Sharma , B. P., Kunum, A., Gowda, S. K., & Bandla, R. (2021). Pharmacological Importance of Chromolaena odorata: a review. International Journal of Pharmaceutics and Drug Analysis, 8–11. https://doi.org/10.47957/ijpda.v9i1.452

[4] Alisi, C. S. & Onyeze, G. O. C. (2008). Nitric oxide scavenging ability of ethyl acetate fraction of methanolic leaf extracts of Chromolaena odorata (Linn.). African Journal of Biochemistry Research, 2(7), 145–150. https://doi.org/10.5897/ajbr.9000174

[5] Chiabi, A., Kenmogne, M. H., Nguefack, S., Obadeyi, B., Mah, E., Meka, F. Z., Tchokoteu, P.-F., Mbonda, E., & Ekoe, T. (2011). The empiric use of palm kernel oil in neonatal skin care: Justifiable or not? Chinese Journal of Integrative Medicine, 17(12), 950–954. https://doi.org/10.1007/s11655-011-0938-1

[6] Dijkstra, A. J. (2016). Lauric oils. Elsevier EBooks, 517–522. https://www.sciencedirect.com/referencework/9780123849533/encyclopedia-of-food-and-health

[7] El-Shahawi, M. S., Al-Hindi, R. R.and Bin-Masalam, M. S. (2017). Antioxidant and antibacterial characteristics of phenolic extracts of locally produced honey in Saudi Arabia. International Journal of Food Science Nutrition. 62: 513-7.

[8] Igwe, C. U., Nwaogu, L. A., & Ujuwondu, C. O. (2007). Assessment of the hepatic effects, phytochemical and proximate compositions of Phyllanthus amarus. African Journal of Biotechnology, 6(6), 728–731. https://doi.org/10.5897/ajb2007.000-2079

[9] Imran, M., Salehi, B., Sharifi-Rad, J., Aslam Gondal, T., Saeed, F., Imran, A., … Estevinho, L. M. (2019). Kaempferol: A Key Emphasis to Its Anticancer Potential. Molecules, 24(12), 2277. https://doi.org/10.3390/molecules24122277

[10] Islam, M. T., Rahman, M. T., Mia, E., Hossam Kamli, Mohamod, A., Uddin, M. B., … Md Shimul Bhuia. (2025). Anticancer potential of daidzin: a comprehensive literature review. Medical Oncology, 42(8). https://doi.org/10.1007/s12032-025-02839-6

[11] Jasemi, S. V., Khazaei, H., Morovati, M. R., Joshi, T., Aneva, I. Y., Farzaei, M. H., & Echeverría, J. (2024). Phytochemicals as treatment for allergic asthma: Therapeutic effects and mechanisms of action. Phytomedicine, 122, 155149. https://doi.org/10.1016/j.phymed.2023.155149

[12] Karen, S. C., Patricia, P., Almeida, D. M., & Milena, B. S., (2022). Bioactive compounds modulating Toll-like 4 receptor (TLR4)-mediated inflammation: pathways involved and future perspectives, Nutrition Research, 107,pg 96-116.

[13] Lee, Y., Lee, C., Lee, S.-H., & Lee, Y.-J. (2025). Effect of Butein, a Plant Polyphenol, on Apoptosis and Necroptosis of Prostate Cancer Cells in 2D and 3D Cultures. Life, 15(6), 836. https://doi.org/10.3390/life15060836

[14] Lo, S., Leung, E., Fedrizzi, B., & Barker, D. (2021). Syntheses of mono-acylated luteolin derivatives, evaluation of their antiproliferative and radical scavenging activities and implications on their oral bioavailability. Scientific Reports, 11. https://doi.org/10.1038/s41598-021-92135-w

[15] Mba, B. A., Alisi, C. S., & Ene, A. C. (2020). Antioxidant Properties and Protective Effect of Aqueous Anti-Ulcer Drug (AQAUD) against Aspirin-induced Gastric Ulcers in Albino Rats. Asian Journal of Biochemistry, Genetics and Molecular Biology, 9–21. https://doi.org/10.9734/ajbgmb/2020/v3i230081

[16] Mukund, V., Mukund, D., Sharma, V., Mannarapu, M., & Alam, A. (2017). Genistein: Its role in metabolic diseases and cancer. Critical Reviews in Oncology/Hematology, 119, 13–22. https://doi.org/10.1016/j.critrevonc.2017.09.004

[17] Ozcan, M. and Al Juhaimi, F. (2019). "Honey as a source of natural antioxidants" Journal of Apiculture (J. Apic.) 54:145–154

[18] Pantev, A., Ivancheva, S., Staneva, L., & Serkedjieva, J. (2006). Biologically Active Constituents of a Polyphenol Extract from Geranium sanguineum L. with Anti-Influenza Activity. Zeitschrift Für Naturforschung C, 61(7-8), 508–516. https://doi.org/10.1515/znc-2006-7-807

[19] Parasuraman, S., Thing, G. S, Dhanaraj, S.A. (2014). Polyherbal formulation: Concept of ayurveda. Pharmacogn Rev. 2014;8:73–80.

[20] Park, K. (2023). The Role of Dietary Phytochemicals: Evidence from Epidemiological Studies. Nutrients, 15(6), 1371. https://doi.org/10.3390/nu15061371

[21] Patel, K., & Patel, D. K. (2024). Biological Potential and Therapeutic Effectiveness of Phytoproduct "Fargesin" in Medicine: Focus on the Potential of an Active Phytochemical of Magnolia fargesii. Recent Advances in Inflammation & Allergy Drug Discovery, 18(2), 79–89. https://doi.org/10.2174/0127722708286664240429093913

[22] Pichat, P. (2013). Self-Cleaning Materials Based on Solar Photocatalysis. Elsevier EBooks, 167–190. https://doi.org/10.1016/b978-0-444-53872-7.00008-x

[23] Rezvani, A. H., Overstreet, D. H., Perfumi, M., & Massi, M. (2003). Plant derivatives in the treatment of alcohol dependency. Pharmacology Biochemistry and Behavior, 75(3), 593–606. https://doi.org/10.1016/S0091-3057(03)00124-2

[24] Rosa, A., Isola, R., Pollastro, F., & Nieddu, M. (2021). Effect of the natural polymethoxylated flavone artemetin on lipid oxidation and its impact on cancer cell viability and lipids. Fitoterapia, 156, 105102–105102. https://doi.org/10.1016/j.fitote.2021.105102

[25] Sharifi-Rad, J., Quispe, C., Imran, M., Rauf, A., Nadeem, M., Gondal, T. A., … Kamal, R. M. (2021). Genistein: An Integrative Overview of Its Mode of Action, Pharmacological Properties, and Health Benefits. Oxidative Medicine and Cellular Longevity, 3268136. https://doi.org/10.1155/2021/3268136

[26] Shikha Sharma.and Supriya Bhardwaj. (2016). "Polyherbal Formulations: Concept of Ayurveda," International Journal of PharmTech Research, Vol. 2, No. 4, pp. 2364-2372.

[27] Sohrab, M. H., Hasan, C. M., & Rashid, M. A. (2002). Lunamarin C, a New Terpenoid Coumarin from Clausena heptaphylla. ChemInform, 33(50), 154–154. https://doi.org/10.1002/chin.200250154

[28] Song, L., Liang, X., & Zhou, Y. (2014). Estrogen-mimicking isoflavone genistein prevents bone loss in a rat model of obstructive sleep apnea-hypopnea syndrome. Int J Clin Exp Pathol , 7(4), 1687–1694.

[29] Suvarna, V., Bore, B., Bhawar, C., & Mallya, R. (2022). Complexation of phytochemicals with cyclodextrins and their derivatives- an update. Biomedicine & Pharmacotherapy, 149, 112862. https://doi.org/10.1016/j.biopha.2022.112862

[30] Xue, J.-C., Yuan, S., Meng, H., Hou, X.-T., Li, J., Zhang, H.-M., … Zhang, Q.-G. (2023). The role and mechanism of flavonoid herbal natural products in ulcerative colitis. Biomedicine & Pharmacotherapy, 158, 114086. https://doi.org/10.1016/j.biopha.2022.114086

[31] Yang, Y., & Ling, W. (2024). Health benefits and future research of phytochemicals: a literature review. The Journal of Nutrition, 155(1). https://doi.org/10.1016/j.tjnut.2024.11.007