International Journal of Research in Pharmacology & Pharmacotherapeutics (IJRPP)

IJRPP |Vol.15 | Issue 1 | Jan - Mar -2026

www.ijrpp.com

ISSN: 2278-2648

DOI : https://doi.org/10.61096/ijrpp.v15.iss1.2026.242-253

Review

Natural Colourants from Tagetes Erecta (Marigold): Chemistry, Health Benefits, and Food Industry Applications

Dr. L.V. Vigneshwaran*, Mohammed Riyaskhan. M, Siva Ranjani. A, Balamurugan. G, Mohankumar. S, Thilagavathi. M, Dharsini. V

RKP College of Pharmacy, Krishnagiri, Tamil Nadu – 635001

*Corresponding Author: Dr. L.V. Vigneshwaran
Email Id: vigneshwaran85@gmail.com

Published on: 02.02.2026

Published by: Futuristic Publications

Abstract

Essential non-wood forest products utilized in a variety of industries, such as food, textiles, and cosmetics, are natural colorants and dyes. Natural dyes that are safe for the environment are becoming more popular as synthetic colours become less popular due to worries about their possible carcinogenic and mutagenic effects. A customer's perception of flavour and decision to buy a product are influenced by colour, which is an important component of food quality. Colour additives have been used in food since the Bronze Age in Europe and were first recorded in China circa 2600 BC. The Asteraceae family includes the marigold flower, Tagetes erecta L., which is an important source of natural colorants. Although it is widely grown in countries like China, it is native to Mexico and South America. Lutein makes up 80–90% of the total carotenoids in Tagetes erecta flowers, making it one of the best natural sources of the xanthophyll carotenoids zeaxanthin and lutein. Terpenoids, phenolic substances (like chlorogenic acid), and flavonoids (like quercetin and rutin) are other important phytochemicals found in marigold. Antibacterial, antinociceptive, anti-inflammatory, antioxidant, hepatoprotective, anti-cancer, antiepileptic, anti-diabetic, anti-depressant, mosquitocidal, and anti-fungal properties are only a few of the many pharmacological activity exhibited by T. erecta. Marigold is a versatile crop from an industrial standpoint. Its natural colorants, lutein and zeaxanthin, are used in the food industry to give items a yellow-to-orange hue, and in the poultry sector to improve the colour of egg yolks and broiler skin. Additionally, it is used in the pharmaceutical and cosmetic sectors, agriculture as a bio-fumigant, and textiles for environmentally friendly dyes.

Keywords: Natural Colourants, Tagetes Erecta, Marigold Flower, Marigold Powder, Food, wet Noodle.

INTRODUCTION

"Pigments play a vital role in sustaining life on Earth." (Britton, 1995) Natural colorants and dyestuffs are a significant class of non-wood forest products used in the manufacture of confections, other food items, textiles, cosmetics, medicines, leather, paper, paint, ink, and other goods (1). Synthetic hues have several drawbacks. Certain artificial colours that are even carcinogenic and mutagenic have been banned. Natural dyes are becoming more popular in this day and age of consumers who care about the environment, mainly because research indicates that these dyes are good for the environment and human health (2). Natural colours are widely available and environmentally safe (3).

WHY ARE COLOUR ADDITIVES USED IN FOODS?

The first to feast is the eyes. This is an old axiom with very significant meaning and depicts how colours in life have importance. People's perception is usually influenced by the appearance of the food, and this indicates the flavour. So, it is important to note that the colour of a food or beverage often dominates over other sources of information regarding the flavour.

From various studies it has been observed that colour of a food or beverage can play a profound role in flavour perception (4). One crucial aspect of food quality is its colour. The goal of colouring food is to make it more enticing and to counteract colour loss during processing, to enhance the product's quality and persuade a customer to purchase it (5,6).

HISTORY

The use of natural dyes was first documented in writing in China around 2600 BC, and the Bronze Age in Europe is when colorants were added to food. Additionally, it is said that circa 1500 BC, candy producers in Egyptian cities added wine and natural ingredients to enhance its appearance. In 1856, Sir William Henry Perkin created the first artificial colour mauvine. The majority of synthetic colours made from petroleum-derived compounds, such as aniline, were produced and recovered from the turn of the 19th century. Because the raw materials for these colours came from coal, they were dubbed "coal-tar" colours (7).

CLASSIFICATION OF NATURAL COLOURANTS

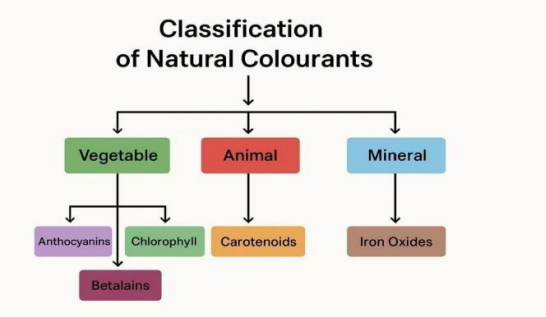

Figure.1: Classification of Natural Colourants

NATURAL COLOURANTS TAGETES ERECTA

Natural plant-based products have been utilized for a variety of reasons throughout human history. Numerous of these organic goods have biological activity that may be involved in the development of new drugs design. The Indian medical system referred as "Ayurveda" mostly use medications derived from plants or formulations to address a range of conditions, such as cancer. Herbal medications offer enormous expansion potential on the international marketplace (8). The marigold, or Tagetes erecta L., is an annual herb that grows in Mexico and South America. It is a member of the Asteraceae family and a natural forage plant. Another name for this plant is hibiscus (9). It can be used as a food spice, medicinal plant, or decorative flower (10,11). Numerous bioactive substances, such as carotenoids (12), flavonoids (13), phenolic acids (14), and thiophenes (15), have been found in marigold. China cultivates it extensively due to its great resilience to weather, wide range of adaptation, lengthy flowering season, variety of blooms, and pure floral colours (10,11).

Figure:2 NATURAL COLOURANTS TAGETES ERECTA

TAXONOMICAL

Native to Mexico and other warmer regions of America, Tagetes erecta is a robust branching herb that has been neutralized in various tropical and subtropical regions, including as Bangladesh and India.

TABLE:1 TAXONOMICAL

Kingdom;	Plantae
Order;	Asterales
Family;	Asteraceae
Subfamily;	Asteroideae
Class;	Magnoliopsida
Division;	Magnoliophyta
Genus;	Tagetes
Species;	erecta

VERNACULAR NAMES

Language	**Name**	**Language**	**Name**
Marathi	Zendu	Sanskrit	Sandu
Hindi	Gendu	Punjabi	Tangla
Bengali	Genda	Malayalam	Chendumalli
Gujarati	Guliharo	Telugu	Bantichettu

Manipuri	Sanarei	Urdu	Genda
Konkani	Gondiphool	Kannada	Chenna mallige

PHYTOCHEMICAL PROFILE OF MARIGOLD

Marigold (Tagetes spp. and *Calendula officinalis*) contains a wide range of phytochemicals, including carotenoids, flavonoids, terpenoids, phenolic acids, and volatile oils. Together, these compounds contribute to its value in both industry and medicine.

1. CAROTENOIDS

- Tagetes erecta is one of the richest natural sources of lutein and zeaxanthin, two xanthophyll carotenoids known for their antioxidant and eye-protective benefits.
- Depending on the cultivar, harvest stage, and climate, the amount of lutein in T. erecta petals can range from 8 to 14 g/kg dry weight (16).
- About 80–90% of the total carotenoids in marigold flowers are made up of lutein, with zeaxanthin making up the remaining 5–8%.

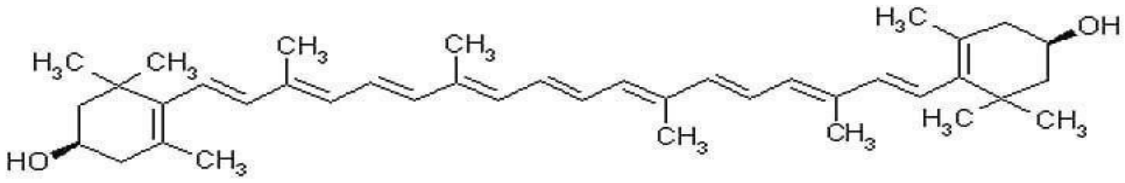

Figure.3: Structure of Lutein

2. FLAVONOIDS

- Marigold mainly contains the flavonoids quercetin, rutin, apigenin, isorhamnetin, and kaempferol.
- According to quantitative tests, C. officinalis flowers have a flavonoid content of 1.5– 3.5 mg/g dry weight.

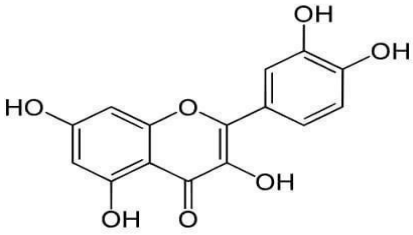

Figure.4: Structure of Quercetin

3.TERPENOIDS AND ESSENTIAL OILS

- A complex blend of monoterpenes, including limonene, is present in the essential oils of Tagetes erecta and T. minuta .Sesquiterpenes (caryophyllene, tagetone, and αterpineol) and ocimene, p-cymene.
- Usually, fresh blooms yield 0.1–0.3% (v/w) of oil, with tagetone being the main constituent.

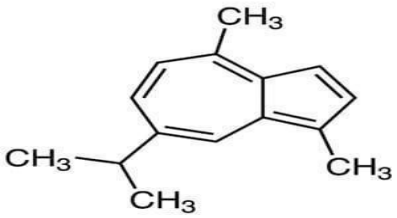

Figure.5: Structure of Sesquiterpene

4. PHENOLIC COMPOUNDS

- Marigold contains several important phenolic acids, including gallic acid, caffeic acid, chlorogenic acid, and ferulic acid.
- Chlorogenic acid, in particular, contributes to the medicinal value of marigold because of its strong antioxidant and antibacterial properties.
- These phenolics have anti-aging, cardiovascular, and free-radical scavenging qualities.

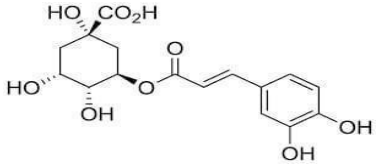

Figure.6: Structure of Chlorogenic acid

COLLECTION

- In December 2019, the Tagetes erecta flowers were gathered at the "Poosanthai" market in the Thanjavur district of Tamil Nadu, India.
- To get rid of any remaining contaminants, the gathered flowers were repeatedly cleaned with distilled water.
- The old, contaminated, and fungus-infected parts of the blossoms were carefully examined and removed. The healthy flowers were then dried at room temperature, ground into a powder using a grinder, and stored for further analysis.

CULTIVATION AND HARVESTING

SEASON	SOWING TIME	TRANSPLANTING TIME	HARVESTING
Rainy	June-July	July-Aug	September- October
Winter	September-October	October-November	November-December
Summer	January	February	March-April

Table ;2 Cultivation and Harvesting Time of Marigold

EXTRACTION

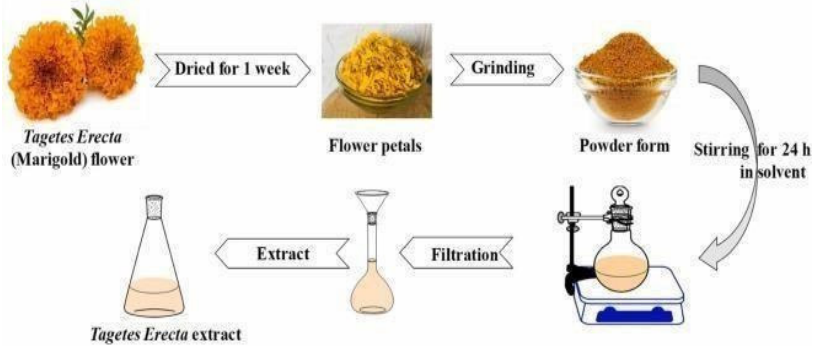

Figure:3 Extraction Of tagetes Erecta

NATURAL FOOD COLOURANTS MAKING OF WET NOODLE

MATERIALS AND METHODS

1.MATERIALS

- Freshly bloomed marigold flowers purchased in Jakarta, Indonesia, were used as the primary material for preparing the marigold powder in this study.

- MP was made using an oven (Memmert UNB 500), a dry blender (Phillips), and a sieve shaker (Retsch). Wet noodles were made with a Fomac noodle maker, an Oxone knife, a Hitachi burner, and a Phillips mixer. Additionally, a desiccator (Duran), analytical and table balance (Ohaus), glassware (Iwaki Pyrex), pH meter (Metrohm), chromameter (Konica Minolta CR 400) and granular materials attachment (Konica Minolta CR A50) for colour analysis, furnace (Thermolyne 62700), spectrophotometer (Hitachi), and texture analyser (TAXT Plus) for texture analysis were used in the analyses of MP and wet noodles.

Figure:4 Tagetes Erecta (Marigold), Dry blender, Oven, Noodle Maker

Dry Blender (Philips)

Oven (Memmert UNB 500)

Fomac Noodle Maker

2.REASEARCH METHOD

Wet noodles with different MP concentrations (0%, 0.25%, 0.5%, 0.75%, and 1%) were made using an experimental method in this study. The physical (colour, cooking loss, water absorption) and chemical (total carotenoids content) properties of the resulting wet noodles are next examined using five replications. In addition, the best wet-noodle formulation was identified by evaluating sensory attributes using both hedonic and scoring tests.

3.MARIGOLD POWDER PRODUCTION

With changes, marigold powder (MP) has been prepared in accordance with (17) and (18). The MF was cleaned, sorted, and given a distilled water wash. The petals were cleaned and then dried for 24 hours at 50±5°C in an oven. To get MP, the dried marigold was mashed in a dry blender and sieved through a 60-mesh sieve shaker. The moisture content of MF and MP was measured using the ovendrying method (AOAC, 2005), following the formula below:

Moisture Content (%) = (Initial weight of the sample − Final weight of the sample) / Initial weight of the sample × 100%

Additionally, the resultant powder and MF were subjected to colour analysis, including hue and L. The yield of MP was computed using the following formula (19,20).

Yield (%) = Weight of Dried Marigold(g) / Weight of Powder(g)××100%

The total carotenoid content of MF and MP was analysed using modified methods from Šivel et al. (2014) (22), Siriamornpun et al. (2012) (21), and Toiu et al. (2008) (23). Standard curves and sample analysis at 450 nm are used to determine the carotenoid concentration. The standard curve was created by weighing 0.0025 g of pure carotene, dissolving it in 0.25 mL of chloroform, and then diluting it with petroleum benzene. Acetone and petroleum benzene are then added to the diluted solution until it reaches a concentration of 0.2-0.8 ppm. The blank was made up of 5 mL of petroleum benzene diluted with 0.3 mL of acetone.

4.WET NOODLES MAKING

First, the water was used to dissolve the salt. After that, a mixer set to speed 2 is used to uniformly stir the wheat flour for 30 seconds. After adding the salt solution gradually, it was agitated for two minutes. The dough was then continually kneaded for four minutes after the different MP concentrations were introduced. After that, the dough was flattened to a 1.5 mm thickness. After the fifth sheet was made, the dough was rested for 15 minutes at room temperature, then passed through the noodle roller seven consecutive times to form uniform sheets. A noodle cutter was then used to shape the dough sheets into noodle strands. After boiling the noodle dough in water (1:10) for three minutes, it is drained (24).

PHARMACOLOGICAL ACTIVITIES

ANTI-BACTERIAL ACTIVITY

Alcaligens faecalis, Bacillus cereus, Campylobacter coli, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus vulgaris, Streptococcus mutans, and Streptococcus pyogenes are all susceptible to the antibacterial action of several Tagetes erecta flower solvents. The flavonoid exhibits a maximal zone of inhibition for Klebsiella pneumoniae (29.50 mm) and has antibacterial action against all tested pathogens. One of the possible components for its antibacterial activity is flavonoid-patulitrin (25). The Neisseria gonorrhoeae strain was most inhibited by the floral portions (26).

ANTINOCICEPTIVE AND ANTI-INFLAMMATORY ACTIVITY

Chloroform, methanol, and the ether fraction of Tagetes erecta have been shown to have antinociceptive and anti-inflammatory properties utilizing acetic acid-induced writhing in mice and carrageenan-induced paw oedema in rats (27).

ANTIOXIDANT ACTIVITY

Using, DPPH, thiocyanate, ß-carotene bleaching, free radical scavenging activity, and the oxidation of deoxyribose test, Tagetes erecta flowers' essential oil demonstrated antioxidant activity (28).

HEPATOPROTECTIVE ACTIVITY

When compared to the CCl4-intoxicated group, the ethyl acetate fraction of T. erecta at a dose of 400 mg/kg orally dramatically reduced the high serum levels of ALT, AST, ALP, and bilirubin nearly to the normal level. Apart from some cytoplasmic vascular degeneration near the portal tracts, along with moderate and scattered lobular inflammation, the liver tissues of rats treated with 400 mg/kg of the extract plus CCl_4 showed significant signs of recovery (29).

ANTI-CANCER ACTIVITY

Marigold has been utilized for many therapeutic purposes as a medicinal herb for a long time. Ethanol and ethyl acetate extracts of marigold flowers were examined for their cytotoxic activity as well as their ability to inhibit the enzymes tyrosinase and elastase. The cytotoxic effects of the two extracts were evaluated using H460 lung cancer cells and CaCO2 colon cancer cells (30).

ANTIEPILEPTIC ACTIVITY

In vivo tests, including pentobarbitone-induced sleeping time, MES and PTZ-induced convulsions, potentiation of PTZ-induced convulsions, spontaneous locomotor activity, forced swim test, and learned helplessness test model, were used to assess the ethanolic extract Tagetes erecta.Tagetes erecta's ethanolic extract exhibited antiepileptic properties. The findings suggest that the ethanolic extract may reduce the seizure threshold in epileptic patients. However, because it also increases the risk of triggering seizures, its use in individuals with epilepsy should be approached with caution (31).

ANTI-DIABETIC ACTIVITY

After treatment with the standard drug glibenclamide, blood glucose levels initially rose at 30 minutes and then gradually decreased over the next 120 minutes. The administration of Tagetes erecta extracts was found to raise glucose levels after 30 minutes, and the hypoglycaemic impact didn't appear until 120 minutes later (32).

ANTI-DEPRESSANT ACTIVITY

The marigold, Tagetes erecta, had some antidepressant properties. A study was conducted to clarify the hydro methanolic flower extract of T. erecta's antidepressant properties. A forced swim test was used to assess the extract's antidepressant potential in mice. In the mice forced swim test, T. erecta considerably reduced the immobility duration (33).

MOSQUITOCIDAL ACTIVITY

The mosquitocidal properties of Tagetes erecta flower ethanolic extract and its petroleum ether and chloroform soluble fractions against Culex quinquefasciatus larvae have been studied. The WHO standard approach was used to assess the larvicidal impact of ethanol extract and its solvent fractions against various C. Quinquefasciatus instars (34).

ANTI-FUNGAL ACTIVITY

At a dosage of 2000 parts per million, the fungitoxic activity of Tagetes erecta leaf essential oil completely inhibited the growth of the damping off pathogen Pythium aphanidermatum (35).

INDUSTRAIL APPLICATION

Marigold has become a versatile industrial crop used in the food, textile, pharmaceutical, cosmetic, and agricultural industries. Its natural carotenoids,

essential oils, and bioactive chemicals, which are becoming more and more popular as sustainable and environmentally friendly substitutes for synthetic goods, are the main drivers of its usage.

1.FOOD INDUSTRY

NATURAL COLOURANTS

- Tagetes erecta is the source of lutein and zeaxanthin, which are frequently utilized as natural food colouring.
- These pigments give dairy products, baked goods, drinks, and confections a yellow to orange hue.

POULTRY INDUSTRY

- To improve the colour of broiler skin and egg yolks, marigold petal powder and extracts are added to chicken feed.
- According to studies, adding 100–200 mg/kg of lutein to the diet greatly increases the yolk colour score (up to 12 on the Roche scale) without having an impact on egg production.

2.TEXTILE AND DYE INDUSTRY

- Depending on the extraction technique and mordants employed, marigold flowers can yield environmentally friendly dyes that range in colour from bright yellow to deep orange.
- It is an economically feasible source of natural textile dyes, with a dye output of roughly 1.5–2.5% of dried petal weight.

3.AGRICULTURE

BIO-FUMIGANT AND SOIL IMPROVER

- Thiophenes and other allelopathic substances released by marigold roots inhibit nematodes, soil fungus, and insect pests.

PEST MANAGEMENT

- Meloidogyne numbers are decreased by Tagetes erecta.spp. (root-knot nematodes) in contaminated soils by 60–70%.
- Additionally, marigold essential oils serve as natural insect and grain pest repellents.

4.COSMETIC AND PERSONAL CARE INDUSTRY

- Calendula officinalis marigold extracts are commonly used in lotions sunscreens, face cleansers, and anti-aging treatments.
- Marigold extract enhanced with 2–5% lutein offers UV protection and can minimize oxidative skin damage by up to 40%, according to cosmetic research.

5.PHARMACEUTICAL AND NUTRACEUTICAL INDUSTRY

- Marigold-derived lutein capsules are sold all over the world as supplements for eye health.
- Marigold extract has a typical lutein level of 10–20% in nutraceuticals.
- Because of its antibacterial and relaxing qualities, marigold oil is utilized in aromatherapy, herbal remedies, and traditional therapeutic methods.

RESULTS AND DISCUSSION

Phytochemical Richness of *Tagetes erecta* and Its Relevance as a Natural Colourant Analysis of the reviewed studies confirms that *Tagetes erecta* flowers are an exceptional reservoir of natural pigments, particularly carotenoids. Among these, lutein dominates the pigment profile, constituting the majority of total carotenoids present in marigold petals. Reported concentrations vary with cultivar, environmental conditions, and maturity stage, but consistently demonstrate that marigold surpasses many other plant sources in lutein yield. This high pigment density explains the intense yellow–orange coloration obtained from marigold extracts and supports their suitability as natural colourants in food and allied industries.

Beyond carotenoids, marigold flowers contain a diverse array of secondary metabolites, including flavonoids, phenolic acids, and terpenoids. These

compounds contribute not only to colour stability but also to the functional value of marigold-derived products. The coexistence of pigments with antioxidant phenolics is particularly important, as it may reduce oxidative degradation during processing and storage, thereby improving the shelf life of coloured products.

CONCLUSION

Native to Mexico and South America, marigold (Tagetes erecta) is a sturdy and adaptable annual herb that is rich in bioactive substances like carotenoids, flavonoids, and phenolic acids. It is among the greatest natural sources of lutein (80–90% of total carotenoids) and zeaxanthin (5–8%), two xanthophyll carotenoids with antioxidant and eye-protective qualities. The study describes the application of Marigold Powder (MP) in concentrations between 0.25% and 1% as a natural colorant in wet noodles. To identify the optimal formulation, the finished wet noodles' physical, chemical (total carotenoids concentration), and sensory characteristics were examined. Marigold is a valuable industrial crop utilized in the textile, pharmaceutical (e.g., eye health supplements), cosmetic (UV protection, anti-aging), and agricultural (bio-fumigant, pest repellent) industries, in addition to its ability to colour food. Significant pharmacological effects, such as antibacterial, anti-inflammatory, antioxidant, anti-cancer, and anti-diabetic qualities, are also displayed by it.

REFERENCE

1. Křížová, H. (2015). Natural dyes: Their past, present, future and sustainability (pp. 59– 71).
2. Singh, R., & Srivastava, S. (2015). Exploration of flower based natural dyes—A review.
3. Research Journal of Recent Sciences, 4((IVC-2015)). https://www.cabdirect.org/cabdirect/abstract/20153319056.
4. Deka, B., Deka, P., Borgohain, R., & Neog, M. (2014). Exploration of plant derived natural dyes in Assam.
5. Lawrence L. Garber, Eva M. Hyatt, Richard G. Starr: The effects of food color on perceived flovor, Journal of Marketing Theory and Practice, 59, (2000)
6. M. Madhava Naidu, H.B. Sowbhagya: Technological Advances in Food Colors, Chemical Industry Digest., (2012)
7. Sahar S.A. Soltan, Manal M.E.M. Shehata: The Effects of Using Color Foods of Children on Immunity Properties and Liver, Kidney on Rats, Food and Nutrition Sciences, 3, 897904, (2012)
8. Adam Burrows J.D., Palette of Our Palates: A Brief History of Food Coloring and Its.
9. Regulation, Comprehensive Reviews in Food science and Food Safety, 8, 394. (2009)
10. Dixit P, Tripathi S, Verma NK (2013). A brief study on marigold. International Research Journal of Pharmacy, 4, 43-48.
11. Zhang, Z.C.; Hu, S.H.; Peng, Y.Q.; Yan, H.S.; Xiao, F.; Gao, J.;Wu, J.J.; Zhou, X.; Xu, X.Y.; Xu, L.; et al. The complete chloroplast genome of Mexican marigold (Tagetes erecta, L., Asteraceae). Mitochondrial DNA Part B 2019, 4, 3587–3588. [CrossRef] [PubMed]
12. Gong, Y.; Liu, X.; He, W.H.; Xu, H.G.; Yuan, F.; Gao, Y.X. Investigation into the antioxidant activity and chemical composition of alcoholic extracts from defatted marigold (Tagetes erecta, L.) residue. Fitoterapia 2012, 83, 481–489. [CrossRef] [PubMed]
13. Hou, Z.; Liu, J.; Cai, M.; Liu, Y.; Mu, L.; Gao, Y.; Wanapat, M.; Huang, B. Enriching the nutritive value of marigold (Tagetes erecta L) crop residues as a ruminant feed by lactic acid bacteria during ensilage. BMC Vet Res. 2021, 17, 74. [CrossRef]
14. Rodrigues, D.B.; Mercadante, A.Z.; Mariutti, L.R.B. Marigold carotenoids: Much more than lutein esters. Food Res. Int. 2019, 119,653–664. [CrossRef]
15. Meurer, M.C.; Mees, M.; Mariano, L.N.B.; Boeing, T.; Somensi, L.B.; Mariott, M.; Silva, R.D.C.M.V.D.A.F.D.; dos Santos, A.C.;Longo, B.; França, T.C.S.; et al. Hydroalcoholic extract of Tagetes erecta, L. flowers, rich in the carotenoid lutein, attenuates inflammatory cytokine secretion and improves the oxidative stress in an animal model of ulcerative colitis. Nutr. Res. 2019, 66,95–106. [CrossRef]
16. Moliner, C.; Barros, L.; Dias, M.I.; López, V.; Langa, E.; Ferreira, I.C.F.R.; GómezRincón,

17. C. Edible Flowers of Tagetes erecta, L. as Functional Ingredients: Phenolic Composition,

18. Antioxidant and Protective Effects on Caenorhabditis elegans. Nutrients 2018,10, 2002. [CrossRef]
19. Ibrahim, S.R.; Mohamed, G.A.; Thiotagetin, A. A new cytotoxic thiophene from Tagetes.

20. Minuta. Nat. Prod. Res. 2017, 31, 543–547.[CrossRef]

21. Prasad S, Yadav V, Singh A. Lutein: A nutraceutical from marigold with human health benefits. Food Chem. 2021;345:128137.

22. Toliba, A.O., Egorov, M.A., Sukhenko, L.T.and Akmaev, E.P. (2018). Physicochemical properties and food application of marigold flower extracts prepared by conventional and supercritical CO 2 methods. In International Journal of Advanced Research 6(10) 10), 876876885885. https://doi.org/10.21474/IJAR01/7883.

23. Norlaili, A.H., Roselina, K.and Muhammad, T.S. (2014).Effect of Cosmos caudatus Kunth. (Ulam Raja) aqueous and dry extracts on the physicochemical and functional properties, and sensory acceptability of herbal yellow alkaline noodles. MalMalaysian Journal of Nutrition, 20(3), 403403-415.

24. Farooq, A., Ali, S., Abbas, N., Zahoor, N. and Ashraf, M.A. (2013). Optimization of extraction and dyeing parameters for natural dyeing of cotton fabric using Marigold (Tagetes erecta). Asian Journal of Chemistry, 25(11), 5955-5959. https://doi.org/10.14233/ajchem.2013.14202.

25. Sunil, K. and Swati, S. (2013). Effect of organic manure, drying methods on flower yield and carotenoid contents in marigold (Tagetes erecta L.). Asian Journal of Horticulture, 8(2), 385- 390.

26. Siriamornpun, S., Kaisoon, O. and Meeso, N. (2012). Changes in colour, antioxidant activities and carotenoids (lycopene, β-carotene, lutein) of marigold flower (Tagetes erecta L.) resulting from different drying processes. Journal of Functional Foods, 4(4), 757-766. https://doi.org/10.1016/j.jff.2012.05.002.

27. Sivel, M., Kráčmar, S., Fišera, M., Klejdus, B. and Kubáň, V. (2014). Lutein content in marigold flower (Tagetes erecta L.) concentrates used for production of food supplements. Czech Journal of Food Sciences, 32(6), 521-525. https://doi.org/10.17221/104/2014-CJFS.

28. Toiu, A., Oniga, I., Benedec, D. and Duda, M.M. (2008). The total carotenoid content in Tagetes species. Hop and Medicinal Plants, 16(1-2), 163-165.

29. Norlaili, A.H., Roselina, K.and Muhammad, T.S. (20142014).Effect of Cosmos caudatus Kunth. (Ulam Raja) aqueous and dry extracts on the physicochemical and functional properties, and sensory acceptability of herbal yellow alkaline noodles. Mal Malaysian Journal of Nutrition, 20(3), 403403-415.

30. Rhama S, Madhavan S (2011). Antibacterial Activity of the Flavonoid-patulitrin isolated from the flowers of Tagetes erecta L. International Journal of Pharmaceutical Technology and Research, 3, 1407- 1409.

31. Patrick RS, Marijo C, Sandra R (2011). Antimicrobial Activity of flavonoids from Piper lanceaefolium and other Colombian medicinal plants against antibiotic susceptible and resistant strains of Neisseria gonorrhoeae. Sexually Transmitted Diseases, 38, 81- 88.

32. Shinde NV, Kanase KG, Shilimkar VC (2009). Antinociceptive and anti-inflammatory effects of solvent extracts of Tagetes erectus Linn (Asteraceae). Tropical Journal of Pharmaceutical Research, 8, 325- 329.

33. Martha R, Gutierrez P, Luna HH (2006). Antioxidant activity of Tagetes erecta essential oil. Journal of the Chilean Chemical Society, 51, 883-886.
34. Giri K, Bose A, Mishra KS (2011). Hepatoprotective activity of Tagetes erecta against carbon tetrachloride induced hepatic damage in rats. Acta Poloniae Pharmaceutica and Drug Research, 68, 999-1003.
35. Vallisuta O, Nukoolkarn V, Mitrevej A, Sarisuta N, Pimporn L, Phrutivorapongkul P, Sinchaipanid N (2014). In vitro studies on the cytotoxicity, and elastase and tyrosinase inhibitory activities of marigold (Tagetes erecta L.) flower extracts. Experimental and Therapeutic Medicine, 7, 246–250.
36. Shetty LJ, Harikiran H, Fernandes J (2009). Pharmacological evaluation of ethanolic extract of flowers of Tagetes erecta on epilepsy. Journal of Pharmacy Research, 2, 10351038.
37. Rodda R, Kota A, Sreeja K, Raju CH, Valya N (2011). Antidiabetic potential of Tagetes erecta whole plant in streptozotocin induced diabetic rats. Journal of Pharmacy Research, 4, 4032-4034.
38. Khulbe A, Pandey S, Sah PS (2013). Antidepressant action of the hydro methanolic flower extract of Tagetes erecta in mice and its possible mechanism of action. Indian Journal of Pharmacology, 45, 386–390.
39. Nikkon F, Habib RH, Saud ZA, Rezaul KM (2011). Tagetes erecta Linn. and its Mosquitocidal potency against Culex quinquefasciatus. Asian Pacific Journal of Tropical Biomedicine, 1, 186-188
40. Kishore N, Dwivedi RS (2006). Fungi-toxicity of the essential oil of Tagetes erecta against Pythium aphanidermatum fitz. the damping of the pathogen. Flavour and Fragrance Journal, 6, 291-2