

ADVANCES IN VALUE ADDITION OF MARIGOLD

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Abstract

Marigold is most preferred loose flower in India and is extensively utilized in the religious and social functions in the form of a variety of garlands and Gajra. There are huge benefits from the marigold flowers as well, it's utilized in the health sector and also in the protection of crops from plant-parasitic nematodes because it produces compounds like α -terthienyl that act as allelopathic to the number of plant-parasitic nematodes. An efficient marketing channel and network are vital for the flourishing marketing of marigold in terms of production and profit. Proper marketing information and implementation will eventually improvise the cultivators' share of consumer costs. New trends of natural and eco-friendly life style, application of naturally occurring biodegradable phytochemicals in pharmaceuticals, food colourants, and pesticides are increasing. Marigold must be considered as valuable bioresource.

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Introduction

Marigold (*Tagetes* spp. Linn.) belongs to the family Asteraceae and it has different 33 species viz., *T. erecta* (African marigold), *T. patula* (French marigold), *T. tenuifolia*, *T. minuta*, etc., out of which *T. erecta* and *T. patula* these two species have been grown very widely commercially in different agroclimatic conditions whereas, *T. minuta* has been grown in colder regions only. Because of the ease of cultural practices, wide adaptability, long duration of blooming period, having excellent keeping quality and attracting coloured flowers, it has become one of the most popular flower crops.



Area and Production

Commercial cultivation of marigold has been practiced in almost all the states of India. It covers an estimated acreage of 73990 ha, the highest for any loose flower grown in India with a production of 760960 MT flowers (Anon., 2020). In Gujarat area under Marigold crop are 8740 ha and production of 83280 MT. Madhya Pradesh rank first in area and production of marigold with 20740 ha and 270800 MT respectively. Around 30% of the flowers of marigold is being wasted on account of its perishable nature, lack of proper handling and its only uses during festival and marriage season.

Practical Utility

It is especially used for garlands, in worship and decoration. This hardy annual ornamental flowering plant is used as pot plant, bedding and border plants in the landscape. Due to seasonal crops, required short period for its cultivation, it is conveniently grown as a part of a multi-crop system, rotated with other agricultural and horticultural crops. It is also grown as a mixed crop with early period of orchard plantation and on the borders with other plants (e.g., Okra, Tomato, Brinjal, Rice, etc.) providing beneficial effects to the latter. The plant has also some resistance to salinity, water stress and other adverse conditions.

Uses for Value Addition

Presently scientists have identified marigold plants as a potential source for production of eco-friendly natural products and pharmaceutical compounds. Important uses

of excess and off season produce for value addition through product diversification such as use of flowers for pigment extraction, meal production, natural colour dyes, oil extraction from leaves and flowers, etc. can help the farmers to getting maximum farm income. Now a days many industries are interested in marigold cultivation owing to its potential in value addition.

Phytochemicals

Some important phytochemicals are present in marigold are -

- 1) Carotenoids
- 2) Flavonoids
- 3) Terpenoids
- 4) Thiophenes

Carotenoids

Total carotenoids yield in different species of *Tagetes* ranged from 0.18 mg to 4.42 mg/g on fresh weight basis (Barzana et al., 2002). Average content of total xanthophylls was found to be 2.61 mg/g and xanthophyll esters 2.22 mg/g. Petals of *T. erecta* has more carotenoids than seeds and sepals and 200 times more than yellow corn. Extract of petals contains carotenoids in which 0.4 % β - carotene, 1.5 % Cryptoxanthin esters, 86.1 % Xanthophyll esters (in which 80 to 90% Lutein found) and galanine, lycopene, α -carotene, γ -carotene etc.



Uses of carotenoids

- Protective function against damage by light and oxygen
- Provide bright colouration
- Antioxidants
- Source for Vitamin-A
- Prevention of or protection against serious human diseases viz., cancer, heart disease, macular degeneration, cataracts and dermatitis

Flavonoids

Active ingredients are quercetin, hesperetin, naringenin. It has anti-oxidative, anti-carcinogenic and enzyme inhibiting activities, anti-inflammatory activity, effective in

cholesterol metabolism. Flavonoids contents in different varieties of *T. erecta* and *T. patula* is about 9-22% (Wei Li et al., 2007).

Terpenoids

Uses as antioxidants, protect lipid, blood and other body fluid from harmful free radicals viz., single O, hydroxyl, peroxide and superoxide and anti-tumor properties. Terpenoid contents in different *Tagetes* genus: *T. minuta* - 30 to 40%, *T. tenuifolia* - 5 to 10 %, *T. patula* - 13.4 %, *T. erecta* - 4 to 15.8 %.

Thiophenes

These sulphurous heterocyclic compounds are well present in *Tagetes* genus. It is found in *T. minuta*, *T. terniflora*, *T. patula*, *T. campanulata* (highest thiophene contents), *T. erecta* (15-21 mg/kg), *T. filifolia*, *T. laxa* and *T. lemonioid*. Highest concentrations found in roots of plant, primary in the epidermis, vascular axes and endodermis. Concentration of Thiophenes is increase as the plant get older, reaching a maximum during the reproductive stage in *T. patula*. Different types of Thiophenes found in *Tagetes*:

- 1) BBT [5-(3-buten-1-ynyl)-2,20-bithienyl]
- 2) BBTOH [5-(4-hydroxy-1-butynyl)-2,20-bithienyl]
- 3) BBTOAc [5-(4-acetoxy-1butynyl)-2,20-bethienyl]
- 4) a-T (2.20:50,20-terthienyl)

Value Added Poultry Food

Carotenoids are the major source of xanthophylls pigment for poultry food. The pigment is used in food to intensify yellow colour of egg yolks and skin of laying hens (Bocanegra et al., 2014). Dry petals of marigold flower contain about 90 % (W/w) carotenoids mostly compound of esters xanthophylls (Lutein). The petals are dry in such conditions that maximum carotenoids retain in them. These dry petals are finely ground in powder form and added in to the poultry food. Such types of food containing carotenoids, intensify the orange colour of egg yolks and skin of laying hens.

Natural Colour Dye as Food Additives

Since, 20 years of markets, it is very common practices to used natural colour-dye made from carotenoids to colouring of food. With an increasing standard of living in many industrialized countries, consciousness about the health is on the rise, which drive the market to use natural products beneficial to health. In India and Pakistan, the African marigold flowers are used as a source of a yellow cloth dye known as "egandai" or "gendia". It is used extensively in home dye, especially among the poor. With chemical mordants like Alum-p., Chrom-p., Copper-p., it gives bright colours. At present, because of people's trend toward natural and eco-friendly life style, the world over the big share of synthetic colour is gradually replaced by natural colour. The world total share on natural colour sources (marigold, annatto, etc) from plants amounts to 1290 tonnes worth US \$ 4100 million, Countries like Peru, Gautamala, Brazil, Ghana, Dominican Republic export more than 80 per cent, whereas, Indian share is below 1000 kilograms of world trade in natural colours. USA and European countries are the major consumers of marigold products. African countries (Ghana and Zambia) are exporting marigold meals to these countries

which are being used for the production of natural colours and food additives. The lutein of the flower petals of African marigold is the source of carotene for colouring food products.

Pharmaceutical Uses

Marigold petals also have characteristics of anti-fungal, anti-bacterial and anti-inflammatory activities and these can be utilized for production of creams. Skin cream made from marigold petals are available in Western market. One can find many references for using marigold as an antiseptic agent. Marigold extract is also used as an anti-oxidant in pharmaceutical industries.

Marigold is chiefly used as local remedy. It acts as a stimulant and diaphoretic. It has been reported that a marigold flower rubbed on the affected part, is good remedy for the pains and swelling caused by the Bee or Wasp sting. A lotion made from the flowers is most useful for pains and wounds. Water extracted from petals is good for inflamed and sore eyes. Lutein acts as the molecular region of retina and prevent the ocular degeneration. Carotenoids also protect eyes from long term damage by light which can lead to a progressive condition known as age related macular degeneration (AMD). Marigold is very versatile, speeding the healing of wounds, making the skin supple by increasing blood supply to it and soothing pain. Lutein protect artery clogging and appear to help the heart. The purified extract of marigold petals containing lutein dipalmitate has been reported as an ophthalmic agent under the name "Adptonol".

Herbal and Nutritional Products

Revolutionary breakthrough in age-defying supplementation is a scientifically advanced formula designed to help restore deteriorating vital substances in the body and increase cell vitality which is lost as we age. Such formula contains bioperine, marigold extract, pregnenolone and powerful combination of targeted coenzymes, micronutrients and anti-oxidants. Marigold support both skin and connective tissue nutritionally. It is good for energy, mood swings, strengthening the immune system and general healing.

Essential Oils and Their Products

Marigold oil has a sweet, fruity almost citrus like fragrance and is yellow to reddish-amber in colour. It is medium in viscosity that turns thick and even get solidify if expose to air for some time. The essential oils have been found applicable in variety of commercial goods. They are basic raw materials for perfume, flavour and cosmetics industries. They are used in wide range of products like soaps, detergents, cosmetics, disinfectants, deodorant, mosquito repellants, flavorants of food, soft and hard drinks, pharmaceutical, etc. *Tagetes minuta* (Wild marigold) contains essential oil of superior quality with high recovery which range from 0.20 to 0.35 percent. The average yield of oil 50-60 kg per hectare. The price of oil is also very high ranging from 5000-6000 Rs/kg. In Africa it is known as "Khakibush" and also grown in France and North America. The countries like France, Kenya and Australia are the main marigold oil producer in the world. In North-West Himalayan region of India, *Tagetes minuta* has been found in wild as natural form. Marigold oil extracted from leaves, stalks and flowers which picked when the seeds are just starting to form. The main chemical components of this oil are Tagetone, Limonene,

Valeric acid and Ocimene, etc. It contains properties of anti-infections, anti-microbial, anti-biotic, anti-spasmodic, anti-parasitic, insecticides and sedative.

Perfumery Industry

Marigold oil is used extensively in French perfumes. It has been found that marigold oil is most valuable and precious for using in high grade perfumes and cosmetics. The oil is used in compounding high grade perfumes. Keones found in high concentration in marigold oil are the base material for synthesis of valuable aroma chemicals.

Medicinal Uses of Oil



Marigold oil is useful in cases of skin infections and has healing effect on wounds, cuts, callus and bunions. It can also be useful for treating respiratory system. In vapour and aroma therapy marigold oil can be helpful in reducing coughs, bronchitis, chest infection and release of mental tension and depression. As a blended massage oil or diluted in bath, could be assist in healing parasitic and fungal infections. This oil is very powerful and should be used sparingly. It should be avoided during pregnancy and not used on a sensitive skin as it may cause photosensitivity (dermatitis).

Therapeutic Uses

Carotenes are source of Vitamin-A. Vitamin-A (beta-carotene) acts as an anti-oxidant. With vitamin-C and vitamin-E, it helps to neutralize potential cell damage by molecules called free radicals. The extracted juice of marigold petals when heated with equal quantity of ghee is given thrice daily as a remedy against bleeding piles. Flower extract in internal application purifies blood. The juice extracted from the leaves is used for getting relief from boils, car-bunches and ear-aches. Marigold is also an antiseptic used against psoriasis, athlete's foot, acne, diaper rash and ring worm.

As Insect Repellents

A good insect repelling properties are found in the roots, leaves and flowers of marigold and

it often seen juvenile hormonal effect on native ants, flies and mosquitoes. Therefore, marigold oil is being used on industrial scale for formulation of insect repellents.

Nematicidal Uses

Different species of marigold have been reported by many scientists to functions as bio-protecting agent plants against various nematodes spp. and insect and pests. It is used as a nematode trap crop. Marigold plant is a source of Thiophenes which are sulfurous heterocyclic compound derived from polyacetylenes which may be stored in plant tissues. Thiophenes act as toxins that are activated by sun light or UV radiation killing pathogens such as nematodes, insects, fungus and bacteria. Many types of thiophenes (BBT, BBTOH, BBTOAc, a-T, etc.) are present in marigold species like *T. patula*, *T. minuta*, *T. erecta*, *T. multiflora*, etc. Their concentration in a plant vary according to species, stage of plant development and vegetative organs. African marigold (*T. erecta*) contained a-T (a-terthienyl) in a range of 15-21 mg/kg in fresh petals extracted by methanol.

Conclusion

New trend of natural and eco-friendly life style, applications of naturally occurring biodegradable phytochemicals in pharmaceuticals, food colorants, and pesticides are increasing. Marigold (*Tagetes spp.*) must be considered as valuable bioresource. The major bioactive phytochemicals in marigold are carotenoids, terpenoids, flavonoids and thiophenes. The composition of extract from flowers, foliage, stems and roots varies with thiophenes being predominant in root extracts, carotenoids pigments in flower petals and terpenoids in flowers and leaf oil. India possessing an ideal agro-climatic conditions for year-round production of marigold and has a tremendous potential to expand the area under marigold cultivation and diversify in to value added products utilized in medicine, food additives, perfumery and pesticide sectors.

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