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Product Diversification in Floriculture

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ABSTRACT: *Value added floriculture is a process of increasing the economic value and consumer appeal of any floricultural commodity. Value addition ensures high premium to the grower, while providing more acceptable quality products for the domestic and export market. The scenario of floriculture products in India is expanding at a rapid rate and holds very good prospects. Considering this, the floriculture is and will continue to be one of the most lucrative and successful components of diversified horticultural industry. To achieve this goal, policy makers, researchers as well as producers are needed.*

Keywords: *Dry flowers, Essential oil, Edible products, Tinting, Speaking flowers.*

INTRODUCTION

The floriculture industry comprising of cultivation and trade of cut flowers, cut foliages, potted plants, bedding plants, planting material etc., is experiencing rapid transformation. In India, dynamic changes have been seen in decade of the nineties and the consumption of flower is rising significantly.

Among all forms of horti-business activities, floriculture has been identified as one of the possible sector for diversification.

Eventhough floriculture is fast emerging industry in India; the percent share of floriculture is very low compare to other horticulture sector i.e. only 4%. Hence to increase the floriculture export value in international market and domestic market, we should think about our opportunities. In this regard product diversification is one of the possible way, to improve our economic status.

NEED FOR DIVERSIFICATION

The major components of floriculture industry in the country are production of cut flowers, cut foliages, loose flowers and potted plants. However, the statistics about cut flower production is not very much encouraging, the only way to make a dent in the floriculture industry both in the domestic and export market, is to think in terms of our opportunities.

We can achive our goal through identification of crop specific zones (ex: Western Ghats are rich in Ferns, Orchids, Ornamental foliage trees etc), Effective utilization of natural resources and native flowers.

OBJECTIVES OF PRODUCT DIVERSIFICATION

- To improve quality (Through value added packaging)
- To enhance selling (dry flowers, tinted flowers, edible product)
- To gain higher profit (Essential oil, Dry flowers, Speaking flowers etc)
- To minimize post harvest loss (Through value added packaging, dry flowers.)
- Use of unsold flowers (Waste rose petals are used to prepare Gulkand)
- To increase export

VALUE ADDED PACKAGING

- Efficient and timely packing helps to maintain quality and extended vase life in addition to imparting better appearance and attraction.
- The pack house should be covered, to prevent moisture loss.
- Packaging should prevent flowers from physical damage, water loss and external factors problem during transport.

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Table I
Tools for Diversification

Value added packaging	*Essential oil, absolutes and hydrosols*	*Gulkand, Pankuri, Rose hips*
Floral ornaments	Aromatherapy	Jasmine tea
Dry flower and plants	Rose water	Lotus products
Skeletonising	Pigments, natural dyes	Hibiscus preserve, Hibiscus syrup, Hibiscus vodka
Pot pourri	Value added poultry feed	Flower flavours
Addition of fragrance	Insect repellents	Flower butter, Flower honey
Tinting	Edible products	Candied flowers

- Popular Packing materials are cellophane paper, kraft paper, sleeves or corrugated cardboard sheet etc.
- The packaging material should be attractive to attract the customers.

Effect of different packaging films and cold storage durations on keeping quality of gladiolus cut spikes

Table II
Effect of Packaging Films and Cold Storage Durations on Total Water Uptake in Gladiolus Spikes.
(Singh *et al.*, 2007)

Treatment (Packaging film)	*Water uptake (ml) Storage duration (days)*			
	5	*10*	*15*	*Mean*
Cellophane	33.8	24.0	19.4	25.8
Polypropylene	**45.7**	**43.8**	41.7	**43.7**
News paper	34.8	30.1	19.2	28.0
Butter paper	34.0	31.2	22.7	29.3
Brown paper	29.8	26.0	17.8	24.6
Plastic coated paper	**41.7**	**39.8**	37.7	39.3
Control	24.5	5.6	0.3	10.2
Mean	**34.8**	28.6	22.6	-

CD (P=0.05), Treatment=0.6, Storage duration= 0.2 and Interaction = 1.7

Table III
Effect of Packaging Films and Cold Storage Durations on Per cent Floret Opening in Gladiolus Spikes
(Singh *et al.*, 2007)

Treatment (Packaging film)	*Floret opening (%) Storage duration (days)*			
	5	*10*	*15*	*Mean*
Cellophane	21.8 (27.83)	18.7(25.55)	2.5(8.37)	14.33(20.58)
Polypropylene	**68.7(55.98)**	**62(51.96)**	**42 (40.39)**	**57.6 (49.45)**
News paper	22.5 (28.28)	21.3 (27.49)	2.5 (8.79)	15.3 (21.52)
Butter paper	31.8 (34.33)	26.7 (31.07)	2.3 (8.47)	20.3 (24.62)
Brown paper	21.8 (27.83)	18 (25.07)	2.8 (9.5)	14.2 (20.72)
Plastic coated paper	**46.1 (42.80)**	**41.7 (40)**	**31.8(34.33)**	**39.9 (39.05)**
Control	15.3 (23.01)	6 (13.17)	0.9 (5.11)	7.4 (13.76)
Mean	32.60 (34.30)	(27.7630.62)	12.13 (16.39)	

CD (P=0.05), Treatment=0.6, Storage duration= 0.2 and Interaction = 1.7 Figures in parenthesis are arc sine transformed values.

Singh *et al.* (2007) reported the effect of five different packaging films (cellophane, polypropylene, news paper, butter paper, brown paper and plastic coated brown paper) and three cold storage durations (5, 10 and 15 days) @ 6-10^0 C temperature on flower quality of gladiolus cut spikes .Among all different combinations, cold storage of spikes for 10 days with polypropylene packaging followed plastic coated paper maintained good water uptake and improved floret opening.

- The polypropylene and plastic coated paper packaging films might possesses low air diffusion rate across the film compared to other films. Initially, continued metabolic activities specially respiration and transpiration of the flowers might have led to the evolution of beneficial equilibrium of modified atmosphere with high CO_2 and low O_2 and high relative humidity within the package. This further might have caused closure of stomata and minimized the respirational loss of carbohydrates as well as transpirational loss of cut spikes. This would further contribute towards minimal cell damage during storage and retain normal cell conditions after storage, which ultimately resulted into normal water uptake, In case of unpacked spikes and other packaging films, undesired gaseous equilibrium appear to have caused higher cell damage resulting in poor water uptake.
- The enhanced bud opening in cut flowers is associated with high cell turgidity and up regulation of optimum metabolic activities with high petal sugar status, higher number of floret opening in polypropylene cut spikes could be attributed to turgidity of the spikes on account of higher water uptake and optimum cell metabolism with sustained levels of the carbohydrates in the tepals. In case of other packaging films, the depletion of carbohydrates might have resulted into failure of florets to open.

Floral ornaments: Garlands, Veni, Gajara, Floral wreath, floral crown and floral bangle

Garlands: These are prepared by using one type of flower or combination of different flowers. Mainly used for marriages, dance ceremonies and other functions.

Flowers: Jasmine, Crossandra, Rose, Tuberose, Marigold etc.

Veni: Used to decorate long plaits of hair in marriages or dance ceremonies. Made on hard cardboard or tough leathery leaves of 90 cm long and 5-10cm breadth.

Flowers: Jasmine, Rose, Tuberose etc.

Floral wreath, bangles and crowns: Floral wreaths are circular in shape, mainly used for condolence functions.

Floral bangles are made by fragrant flowers like Jasmine or Tuberose. Floral crowns are used in ceremonies.

Gajara: Most common in South India. Flowers like Crossandra and Barlaria are generally used in Gajara. Made into mini-garland like short chains. Used as hair adornment.

Boutonnieres and Corsages: Flowers are worn by both men and women on special occasion such as weddings, parties and holiday celebration.

Flowers worn by woman - **Corsages**

A Corsage is a cluster of flowers, foliage and accessories that accents women's dress.

Flower worn by men **–Boutonnieres**

It is usually consists of single flower with a foliage, but recent trend is using of multiple flowers.

Plate I: Floral ornaments

Flowers used: Rose, Orchids, Carnation, Daisy, Gomphrena, Tuberose etc.

Flower arrangements: Art of arranging flowers in different styles.

Plate II: Floral arrangement

Two types: Western and Japanese style.

Essential factors in flower arrangements:

- **Vase**
- **Proportion**
- **Balance**
- **Depth and Rhythm**
- **Emphasis**
- **Colour**
- **Space**

Main components of flower arrangements: Line, Fillers and points

- Western styles: Triangular shape, Round, Oval, L-shape, S-shape and Crescent shape.
- Japanese styles: Ikebana, Moribana, Nageire and Morimono.

Floral bouquet

- A flower bouquet is a collection of flowers in a creative arrangement.
- Flower bouquets can be arranged for the decor of homes or public buildings, or may be handheld.
- Handheld bouquets are classified by several different popular shapes and styles, including nosegay, crescent, and cascading bouquets.

Bouquets arranged in vases or planters for home decoration. They can be arranged in traditional or modern styles.

Floral Rangoli

Selected design is drawn on the ground, after that petal, the whole flowers and foliage are arranged with proper colour combination.

Water floral rangoli: It gives simple and elegant look, flower petals are designed in water surface. Containers are made up of plastic, ceramic or glass material.

- Flowers used for rangoli: Flower petals of varied colors like Bougainvillea, Jasmine, Marigold, Rose, Crossandra, Cocks comb, Gerbera etc.

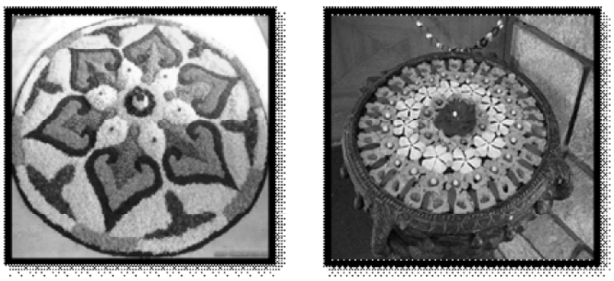

Plate III: Floral and water floral rangoli

Dry Flowers and Plants

Drying and preserving flowers and plant materials is a form of artistic expression that was very popular during the Victorian age and has once again gained popularity. Dried or Dehydrated Flowers or Plant part or Botanicals (Roots, leaves, Stem, Bark or Whole plant) can be used for ornamental purposes. Dried flowers and other plant parts is a Rs. 100 crores industry in India and such dry decorative materials are globally accepted as natural, eco-friendly, long lasting and inexpensive.

India is one of the major exporters of dried flowers to the tune of 5% world trade in dry flowers. This industry shows a growth rate of 15% annually. Potpourris are a major segment of dry flower industry valued at Rs. 55 crores in India alone. Easy availability of products from forests, possibility of manpower available for labour intensive craft making and availability of wide range of products throughout the year are the reasons for development of dry flower industry in India. This industry provides direct employment to around 15,000 persons and indirect employment to around 60,000 persons (Murugan *et al*., 2007a).

Product segmentation: Dried flower and plants, Potpourris, Arrangements, Floral handicrafts, Main blooms, Fillers, Liners and Exotics.

Plate IV: Dry flowers

Drying Methods

Air drying, Sun drying, Embedded drying,Water drying, Microwave oven drying, Glycerin drying, Freeze drying, Press drying,Bleaching, sulphuring, Potpourri and Skeletenizing.

Flowers suitable for drying: Helichrysum, Rose, Zinnia, Orchids, Daisy, Carnation, Celosia, Gomphrena, Calendula, Pansy, Gypsophilla, wood rose, Corn flower, Hydrangeas, Salvia, Tulip, Chrysanthemum etc.

Microwave Oven Drying of Cut Carnation

Table IV
Effect of Different Duration of Microwave Drying on Flower Weight Change (g) in Carnation var. Cano and Kristina

(Biswas and Dhua, 2010)

Treatment	*Weight of flower (g)*					
	Cano			*Kristina*		
	Fresh	*Dried*	*% Decrease*	*Fresh*	*Dried*	*% Decrease*
2 minutes(T_1)	6.68	2.31	65.42	6.31	2.08	67.04
3 minutes(T_2)	6.87	2.05	70.16	6.61	1.88	72.01
4 minutes(T_3)	7.13	1.57	**77.98**	6.33	1.35	**78.67**
C.D. (P=0.05)	0.133	0.058	2.071	0.169	0.077	2.842

Table V
Effect of Different Duration of Microwave Drying on Change in Moisture Content (%) in Carnation var. Cano and Kristina

(Biswas and Dhua, 2010)

Treatment	*Moisture content (%)*					
	Cano			*Kristina*		
	Fresh	*Dried*	*% Decrease*	*Fresh*	*Dried*	*% Decrease*
2 minutes(T_1)	91.12	20.42	77.59	90.96	19.06	79.05
3 minutes(T_2)	91.09	16.98	81.41	90.13	16.13	82.25
4 minutes(T_3)	91.21	13.08	**85.66**	90.96	12.64	**86.10**
C.D. (P=0.05)	NS	2.514	3.519	NS	2.366	3.731

Table VI
Effect of Different Duration of Microwave Drying on Decrease in Flower Diameter (%) in Carnation var. Cano and Kristina

(Biswas and Dhua, 2010)

Treatment	*Flower diameter (cm)*					
	Cano			*Kristina*		
	Fresh	*Dried*	*% Decrease*	*Fresh*	*Dried*	*% Decrease*
2 minutes(T_1)	6.47	6.30	2.63	5.63	5.40	4.09
3 minutes(T_2)	6.40	5.90	7.81	5.90	5.30	10.17
4 minutes(T_3)	6.17	5.33	**13.61**	5.63	4.83	**14.21**
C.D. (P=0.05)	0.097	0.158	1.443	0.117	0.169	2.124

Table VII
Effect of Different Duration of Microwave Drying on Change in Carotene Content (µg/g) in Carnation var. Cano and Kristina.

(Biswas and Dhua, 2010)

Treatment	*Carotene content(µg/g)*					
	Cano			*Kristina*		
	Fresh	*Dried*	*% Decrease*	*Fresh*	*Dried*	*% Decrease*
2 minutes(T_1)	3.88	3.51	9.54	3.78	3.32	12.17
3 minutes(T_2)	3.84	3.15	17.97	3.76	2.78	26.06
4 minutes(T_3)	3.87	3.02	**21.96**	3.78	2.33	**38.36**
C.D. (P=0.05)	NS	0.261	3.308	NS	0.228	3.697

Table VIII
Effect of Different Duration of Microwave Drying on Quality Parameters in Carnation var. Cano and Kristina.

(Biswas and Dhua, 2010)

Treatment	*Visual quality parameters*					
	Cano			*Kristina*		
	Colour	*Texture*	*Appearance*	*Colour*	*Texture*	*Appearance*
2 minutes(T_1)	**3.31**	**2.81**	**3.08**	**3.47**	**3.38**	**3.42**
3 minutes(T_2)	2.66	2.32	2.79	2.79	3.14	2.46
4 minutes(T_3)	2.31	2.17	2.22	2.36	2.54	2.44
CD. (P=0.05)	0.289	0.480	0.575	0.524	0.648	0.648

Flowers of two standard cut carnation varieties viz., Kristina and Cano, harvested at fully opened stage, were subjected to drying treatments in microwave oven, after embedding them in desiccant silica gel for 2 to 4 minutes. The percent loss in weight, moisture content, diameter and carotene contents of flower petal increased with increase in the duration of drying treatment from 2-4 minutes. The loss in weight, moisture content, and decrease in diameter and loss in carotene content was comparatively higher in carnation var. Kristina as compared to var. Cano where all these physiochemical parameters were recorded at marginally lower range. Quality of the flower deteriorates with the increase of duration of drying in micro wave oven. Although, from visual sensory evaluation, it has been found that the variety Kristina scored more colour (3.47), Texture (3.38) and appearance (3.42) than variety Cano [colour (3.31), Texture (2.81) and Appearance (3.08)]. When the flowers embedded with silica gel and kept in micro wave oven for 2 minutes. It can be concluded that shortest duration of micro wave oven drying for a period of two minutes gave best result in carnation. Between the two varieties, Kristina performed better than Cano in microwave oven drying for two minutes, with respect to maintenance of colour and quality.

The quantitative and qualitative characteristics of the dried flowers were influenced by duration of drying treatment. Increased weight loss in microwave oven dried flowers with increased time duration may be due to additive effect of desiccating property of silica gel.

The higher moisture loss with increased duration of microwave drying and temperature rise caused augmented reduction of flower size during drying as compared with lesser duration of drying treatment.

Carotenes are located in grana in chloroplast. Chloroplast looses thylakoids and contains vesicles and plastoglobuli after drying. Thus clearly indicating degradation of pigments on drying for a long duration may create a high temperature which might have aggravated the effect.

Eventhough drying is faster under long duration, the quality parameters were best under shortest duration because it prevents excess colour degradation and maintaining better texture and appearance.

Table IX
Effect of Different Temperatures and Embedding Media on Moisture Content (%) in the Zinnia Flowers (Singh *et al.*, 2004)

Drying temp.	*After 24 h Embedding media Moisture content (%)*		
	M_1 *(Sand)*	M_2 *(Borax)*	M_3 *(Silica gel)*
T_1 (40^0 C)	12.2 (20.5)	11.53 (19.8)	10.6 (19.1)
T_2 (45^0 C)	11.8 (20.1)	11.1 (19.4)	9.8 (18.3)
T_3 (50^0 C)	11.4 (19.8)	8.2 (16.6)	6.2 (14.4)
CD @ 5%	T=0.908,	M=0.908 and	TXM= 1.573.

Figures in parenthesis are arc sine transformed values.

Singh *et al*. (2004) studied the effect of different dehydration treatments with different temperature and media on moisture content of zinnia flowers. Among the three temperatures, 40^0 C with silica gel embedding media for 24 hr has been recorded optimum moisture content (10.6%).

At higher temperature, rate of transpiration is higher. This may be attributed towards higher respiration rate at higher temperature with more ethylene release, which modifies permeability of cell membrane by weakening cell membrane integrity through cellulose and phospholipase enzyme that cause cell leakage and thus, maximum moisture is liberated from cells at higher temperature. Also at higher temperature, surface evaporation of water is higher. With increase in temperature, DPD of air is raised due to decreased relative humidity. This stimulates diffusion of internal moisture to surface and further increases its vaporization rate, leading to higher moisture loss at higher temperature.

Effect of media was also found significant; drying was being much faster with silica gel and borax as compared to sand. This resulted into lower moisture content and higher reduction in flower size with drying in silica gel or borax.

Moisture content in dried flowers influenced longevity. Lower moisture content showed higher longevity. A range of 8-11.5 % moisture content in the dried flowers provided optimum drying with good quality, firmness and showed keeping quality above six months. Excessive drying of flowers resulted into petals shedding during handling. Drying below 8% moisture content showed shedding effect. This may be attributed to excessive loss in moisture, resulting into weakened adhesion and cohesion forces in flower tissue, which has caused softening of middle lamella leading to abscission.

Skeletenizing

As the name implies, this treatment eliminates all tissues but the "skeleton" or veins of leaves are remaining. Skeletonized leaves lend an interesting, lacy appearance to dried arrangements. Heavy-textured leaves are the best choices for this method of preservation. Boil leaves 40 minutes in 1-quart water and 2 tablespoons of lye. Rinse in cold water and scrape or brush the green pulp from the leaves; however, be careful not to destroy the network of veins. To lighten the colour of the leaf skeletons, immerse in a 1-quart water and 2 tablespoon household bleach solution for 2 hours. Rinse and dry (Murugan *et al*., 2007b).

Plant parts used: *Ficus religiosa* leaves, Bahunia leaves etc.

Pot Pourri

Potpourri is usually a mixture of dried, sweet-scented plant parts including flowers, leaves, seeds, stems and roots. The basis of a potpourri is the aromatic oils found within the plant. Two kinds of potpourri can be made - dry and moist. The most common, the dry method, is quicker and easier, but the potpourri does not last as long. Both methods require a "fixative", which is responsible for absorbing the aromatic oils and slowly releasing them. Herbs such as Artemisia, Thyme, Sage, Rosemary, Basil, Achilles (Yarrow), Lavender, Scented Geranium, Mint, Marjoram, Verbena, Anise and Fennel can be used for scent. The herbs and fruits should be thoroughly dried to prevent mildew.

Plate V: Pot pourri

Addition of fragrance: Fragrance is added to dry flowers when used in pot pourri.

- Natural materials: crushed clove, all spice, and orange peel.
- Synthetic perfumes.

Tinting of Flowers

Kids love experimenting with colors and dyes. Coloring flowers with food coloring provides a fun, yet simple way of exploring the color dying process. Not just for kids though, dying flowers with food coloring assists adults with crafts or even accessorizing. For example, a bride sometimes colors bridesmaid bouquets to match the dresses. In addition, flowers dyed with food coloring and then dried can double as supplies for dried flower crafts. Commonly used dyes are Bromocresol green, Bromophenol blue, Phenol red, Erythrosine red, Ammonium purpurate and Eosin. Commonly used chemical dyes concentrations ranges from 0.025-0.3%.

Popular colours: Red, green and yellow.

Effect of different edible dyes on flower colouring of tuberose (*Polianthus tuberosa*). Cv. Single Local and Double Local.

Four different time of immersion (T), viz., 3, 6, 9 and 12 hours

Three different dye concentrations (C), viz., 0.20, 0.25 and 0.30%

Dye: Carmosine Red, Tartrazine Yellow and Phalsa Blue

Table X
Number of Florets Opened Per day in Tuberose on 3rd day of Immersion in Colouring Edible Dyes (Dhaduk and Naik, 2003)

Treatments	*Red*		*Yellow*		*Blue*	
	Single Local	*Double Local*	*Single Local*	*Double Local*	*Single Local*	*Double Local*
T_1C_1	10.48	3.79	9.97	8.39	9.21	8.57
T_1C_2	11.49	3.62	11.29	8.29	9.22	**8.68**
T_1C_3	10.70	3.79	9.93	7.31	9.27	8.62
T_2C_1	**11.95**	3.69	11.09	8.06	9.20	8.33
T_2C_2	11.34	3.82	11.34	8.07	9.30	**8.27**
T_2C_3	**10.39**	3.70	9.82	7.03	**9.02**	8.36
T_3C_1	11.54	3.80	9.61	7.07	9.27	8.66
T_3C_2	11.50	**3.85**	**11.42**	**6.96**	9.08	8.63
T_3C_3	11.35	3.64	11.11	**8.65**	9.19	8.65
T_4C_1	11.85	3.31	10.76	7.10	9.26	8.53
T_4C_2	10.79	3.51	**9.55**	6.97	9.05	8.57
T_4C_3	10.99	**3.27**	9.99	8.28	**9.73**	8.50
Control	10.99	3.50	10.10	7.99	9.20	8.50
S.Em	0.072	0.088	0.080	0.100	0.019	0.017
CD at 5%	NS	NS	NS	NS	NS	NS

The number of florets opening per day was recorded on the 3rd after immersion of spike in the dye solution. The number of florets opening on the third day for red dye was observed the highest (3.85) in 9hr, 0.2% dye treatment and the lower in treatment 12h and 0.3% dye in cv. Double Local. In cv. Single Local, treatment with 6hr with 0.2% showed the highest number of florets opening, while treatment 6hr with 0.3% showed the lowest of the floret opening. On third day in yellow dye, the highest number of florets opening was observed in treatment 9hr with 0.25%dye and lower in treatment 12hr and 0.25% dye in cv. Single Local. In cv. Double Local, treatment 9hr with 0.3% dye showed the highest number of florets, while treatment 9hr with 0.25% showed the lowest. For blue dye, the opening of florets on the third day was found to be the highest in treatment 12 hr with 0.3% dye and the lowest in treatment 6hr with 0.3% concentration of dye in cv. Single Local. In cv. Double Local treatment 3hr with 0.25% showed the highest number of florets opening while treatment6hr with 0.25% dye conc. showed the lowest number. There is no significant difference among the treatments, which indicates there is no adverse effect of the dye on the opening of the florets.

The dye must not be interfering with the activities of the florets opening in the spikes thus leaving no significant effect on the opening of the florets on any of the days after immersion in dyes till the end of vase life of the spikes.

Value Addition by Speaking Flowers

- It is the most recent method to convey the message.
- The message conveyed is printed on the flowers itself
- The message is printed on flowers by using floral printers.
- Flowers cost very high price (25-50 Rs/flower).

Aroma therapy

- Use of volatile plant oil, including essential oil for the physiological well being is called as aroma therapy.
- Methods: Inhalation and application of diluted oil to the skin.
- Flowers: Rose, Jasmine, Lavender, Salvia, Viola etc.

Table XI
Flowers for Aromatherapy

Crop	*Species*	*Source*	*Aromatherapy class*	*Medicinal uses*
Geranium	*Pelargonium graviolens*	Leaves, stems, flowers	Soothing	Skin refresher, astringent
Jasmine	*Jasminum sambac*	Flowers	Soothing, balancing	Antiseptic, emollient
Lavender	*Lavendula angustifolia*	Flowering tops	Calming, balancing, soothing	Antiseptic, anti inflammatory, muscle relaxant, skin conditioners, astringent
Rose	*Rosa damascena*	flowers	Cooling, balancing, calming, toning	Emollient, aphrodisiac, astringent
Salvia	*Salvia officinalis*	Leaves, flower	Stimulating	Soothing agent
Viola	*Viola odorata*	leaves	Calming, balancing	Soothing agent, skin conditioner

Essential oil

- Essential oil is a concentrated hydrophobic liquid containing volatile aroma compounds from plants. Essential oils are also known as volatile oils.
- Uses: Aromatherapy, Medicines, Perfumes, Soaps, Cosmetics and Confectionary etc.
- Methods: Solvent extraction, Distillation, SCDE, Maceration and Enfleurage and Expression.
- Suitable flowers : Jasmine, Rose, Tuberose, Marigold, Lavender, Champaka, Scented geranium etc

(Rajamani, 2003)

Table XII
Effect of Species and Methods of Extraction on Yield of Oils *(Verma et* al., *2001)*

Species	*Yield (%)*		
	Method I	*Method II*	*Mean*
Rosa damascena	0.045	0.024	0.035
Tagetes minuta	**0.745**	0.345	**0.545**
Tagetes erecta	0.347	0.147	0.247
Mean	**0.379**	0.172	-

CD (p=0.5)

Method -0.0178

Species - 0.0218

M X S- 0.030

Method I-hydro distillation, method II- Steam distillation

Verma *et al.* (2001) studied the extraction and evaluation of essence from flowers of rose and marigold using two methods i.e., hydro-distillation and steam distillation. Average yield of oil ranged between 0.024 and 0.0745 %. It also appears that *Tagetus minuta,* which grows wild, gives the highest mean yield of oil, followed by *Tagetus erecta*. Among methods of extraction, and significantly affects the yield and highest mean oil yield (0.37%) was recorded in hydro distillation.

Concrete

- An extract of fresh plant part by the use of a hydrocarbon solvent.
- It is rich in hydrocarbon soluble compounds and devoid of water soluble components.
- It is generally a waxy semi solid dark coloured material.
- 250-350 gm of concrete is obtained from 100 kg of Jasmine flowers.
- Concrete recovery in famous crops :
- Jasmine: 0.28 -0.34%.
- Tuberose- 0.06-0.09%

Hydrosols

- Hydrosol: Water that remains after producing an essential oil via steam or water distillation.
- Uses: Facial toners, skin care products and even used in finger bowls for special dinners.
- Commonly available hydrosols: Lavender, Jasmine, Rose etc.

Rose Water

Rose water is the hydrosol portion of the distillate of rose petals. Rose water, itself a by-product of the production of rose oil for use in perfume, is used to flavour food, as a component in some cosmetic and medical preparations, and for religious purposes throughout Europe and Asia

Uses

Rose water has a very distinctive flavour and is used heavily in Persian and Mesopotamian cuisine-especially in sweets such as nougat, raahat and baklava. For example, rose water is used to give some types of loukoum (or "Turkish Delight") their distinctive flavours. Beside its usage in food, it is also used as a perfume, especially in religious ceremonies (both Muslim and Zoroastrian).

A rose water ointment is occasionally used as an emollient, and rose water is sometimes used in cosmetics such as cold creams. Water used to clean the Kaaba, the Qibla for Muslims located in Mecca, combines Zamza water with rose water as an additive. Rose water is used in some Hindu rituals as well. Rose water also figures in Christianity, particularly in the Eastern Orthodox Church. Rose water was first produced by Muslim chemists in the medieval Islamic world through the distillation of roses, for use in the drinking and perfumery industries. In parts of the Middle East, rose water is commonly added to lemonade. In India, rose water is used as eye drops to clear them. Some people in India also use rose water as spray applied directly to the face for natural fragrance and moisturizer, especially during winters. It is also used in Indian sweets and other food preparations (particularly gulab jamun, named from the Persian word for rose water). Rose water is often sprinkled in Indian weddings to welcome guests.

Gulkand and Pankuri

Gulkannd: It is prepared by mixing equal quantities of rose petals and sugar. It is considered as ayurvedic medicine, mainly used to control eye inflammation and redness, acidity, nose bleeding and vomiting.

Pankuri: Dried rose petals are called as Pankuri. They are used for preparation of cool drinks.

Floral Natural Colours

Natural colours are the colours which are derived from natural edible vegetables, flowers, fruits, spices etc. Flowers can be used to extract dye, which can be used as natural floral dye for colouring textile fiber, lipstick, soaps, fabrics, paints, varnishes, Inks, papers, food, drinks, cosmetics, medicines, toothpaste etc. These natural dyes are cost effective, ecofriendly and has no allergic action on skin.

Ex. Anthracenes, Carotenoids and Flavonoids.

Table XIII
Flowers for Natural Dyes

Flower	*Colour of the dye*
Anthemis nobilis	Deep yellow
Bougainvillea sps	Yellow/orange /brown
Butea monosperma	Yellow/ orange red
Calendula officinalis	yellow
Chrysanthemum sps	yellow
Cosmos sulphureus	Orange red
Crocus sativus	Deep yellow
Dahlia sps	Orange/ peach
Impatiens balsamiana	Brown/orange
Solidogo odora	yellow
Tagetus sps	Yellow, brown

Screening of African marigold cultivars for flower yield and Carotenoid pigments

Table XIV
Carotenoid Content in Different African Marigold Cultivars (Chandrashekara *et al.*, 2005)

Cultivars	*Total Carotenoids (mg/g of fresh petals)*
Pusa Narangi Gainda	2.69
Orange Double	2.66
Hybrid local Sel.-1	1.07
Pusa Basanthi Gainda	1.37
African Tall Double Orange	1.87
Hybrid local Sel.-2	0.20
Hybrid local Sel.-3	0.64
Hybrid local Sel.-4	0.32
Yellow Double	0.87
Lemon Yellow	0.55
CD @ 5%	0.03

Chandrashekara *et al.* (2005) screened ten African marigold cultivars for carotenoid contents. Among the cultivars tested, cv. Pusa Narangi Gainda

produced the highest total Carotenoids per gram of fresh weight of flower petals followed by cv. Orange Double.

The variation in carotene values in the present findings might be due to variations in growing season, temperature and fertility levels. Varietal genetic makeup also one of the important reason.

Value added Poultry Feed

- Carotenoid (Xanthophylls) pigment is used in feed for intensification of yellow colour of egg yolks and broiler skin.
- Dry petals of marigold- 60 % Carotenoid.

The dried petals are finely ground into powder form and added to the poultry feed.

Table XV
Insect Repellants from Flower Crops

Crops	*Species*	*Principle constituent*	*Effect*
Marigold	*Tagetus minuta, Tagetus patula*	Limonene	Repellent for flies and mosquitoes
Chrysanthemum	*Dendranthemum cinerarifolium, Dendranthemum coccineum*	Pyrethrum	Effective on Lepidoptera insects
Periwinkle	*Catheranthus roseus*	Rotenone type	Caterpillar and beetles
Sabadilla lily	*Schoenocaulon officinale*	Sabadilla	Contact and stomach poison for caterpillars, Leaf hoppers, thrips and bugs,

EDIBLE PRODUCTS

Rose Hips

- Ripe berries of rose.
- Important food for all native tribes.
- Rich in vitamin C, Vit-A and anti -oxidants.
- Used for preparation of jam, jelly, syrup, soup, beverages, bread, wine and marmalade.
- Used to treat cold, Influenza and rheumatoid arthritis (because of its anti oxidant property)

Jasmine Tea

- Green tea leaves are mixed with fresh jasmine flowers.
- Most popular drink of Japan.
- It reduces cholesterol level.
- Flowers used for preparation: *Jasminum officinale and J. sambac*

Lotus Products

- Rhizomes are consumed as vegetable either roasted or in curry form.
- Frozen rhizomes are used for Pickle preparation.
- Dry rhizome slices are used for curry or fried chips.
- Tender leaves, petioles and flowers used as vegetables.
- Nuts embedded in the fruit receptacle are edible and nutritious.
- Fresh rhizomes: protein 2.7%, fat 0.11%, reducing sugars 1.10% and Ca 0.06 %.

(Rajeevan and Valsalakumari, 2001a)

HIBISCUS PRODUCTS

Hibiscus Preserve

Hibiscus contains antioxidant that helps to control cholesterol levels and reduce heart diseases. Hibiscus is used in folk medicine to treat hypertension and liver disorders and is used to make popular soft drinks in various countries around the world. Hibiscus petals are covered with lemon juice and micro waved on high for four minutes. Add boiling water, and sugar and stir it well. Cook two minutes, and then stir. Further cooked it for two minutes and allow mixture to cool for about one hour. Once cool, cook it for four minutes, then stir, let cool slightly and pour into a sterilized jar.

Hibiscus Syrup

Hibiscus petals are covered with lemon juice in a deep glass bowl. Micro wave for two minutes on high. Mix sugar and boiling water in a saucer, heat it. Add the petals and lemon juice mixture to the sugar water. Stir it well and heat it to reduce the volume to one third. Strain it to remove petals and store in a covered jar in the refrigerator. This syrup is delicious over fresh fruit, ice creams, custard etc.

Hibiscus Vodka

Add hibiscus syrup, lemon rind and few drops of rose water to the bottle of vodka. Close bottle tightly, shake gently and allow standing at room temperature for one week or more. Strain the mixture and serve.

Flower Flavours

Flowers appeal to far more than eye: they get your taste buds going too. Edible flowers all have unique flavours. Carnation has spicy flvour; day lily has a crisp and sweet flavour, English daisy has grassy and tangy flavour marigold has a spicy flavour and orchid have a warm and peppery flavour. Primrose has a sweet flavour, tulips have crisp and cucumber like flavour, violets have a very sweet flavour, violets have a very sweet flavour, chrysanthemums have a bitter flavour etc.

Other edible products from flowers

- Flower honey.
- Flower butter.
- Candied flower.
- Floral liquor
- Flowers used: Rose, Pansy, Scented geranium, Orchids, African violets etc.

(Rajeevan and Valsalakumari, 2001b)

Value added floriculture is a process of increasing the economic value and consumer appeal of floriculture commodity. Value additition ensures high premium to the grower, while providing more acceptable quality products for the domestic and export market, and it provides the most important aspects of marketing and gives the customers a reason to buy such products.

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