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Perception of Mango Growers towards Enhanced Freshness Formulation (EFF) Technology- A Study in Krishnagiri District of Tamil Nadu

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Mango fruits are perishable, and as a result, they are prone to significant post-harvest losses. However, mango fruits lost roughly 35% of their value at several phases from farm to consumer level. Enhanced Freshness Formulation (EFF) is a relatively new technology that has been proven to help prolong shelf life, minimize insect problems, and improve fruit quality. The objective of the study was analyze the perception of mango growers towards EFF technology. Ex-post facto research design was adopted for the study. Krishnagiri district was selected purposively since it possessed the maximum number of farmers who had adopted EFF technology. The duration of the study was about 1 month, June 2022. Based on simple random sampling, the data has been collected from 120 mango growers by using pre-testing and a well-structured interview schedule. The statistical tool used was descriptive statistics. EFF users placed a higher value on shelf life (4.608) followed by uniform ripening (4.375), fruit freshness (4.083), and finally environmental repercussions (1.8) and minimal adverse health (1.7). EFF technology is considered vital in enhancing fruit quality and prolonging shelf life. These twin benefits can allow farmers to sell fruits in niche and high-value markets, reduce postharvest losses and improve economic returns for the farmers.

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Keywords: Mango; perception; post-harvest loss; EFF technology; pre-harvest spray; post-harvest dip.

1. INTRODUCTION

Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae and it has been entitled the king of fruits. It is also known as the national fruit of India and the most important commercially grown fruit crop in the country with an area 2,31,70,000 ha, production of 20,38,60,000 MT and productivity of 8.8 MT/ha [1]. Mango is currently ranked fifth among the major fruit crops in terms of total production, with India leading the way [2]. Tamil Nadu ranks eighth in area of 1,46,07,000 ha, tenth in production 6,39,64,000 MT and twentieth in the productivity of 4.38 MT/ha [1]. The country has exported 21,033.58 MT of fresh mangoes to the world for worth Rs. 271.84 crores/ 36.23 USD Millions during the year 2020-21 [2].

Krishnagiri district is the leading producer of mango with an area of 33,200 hectares in 2021 [1]. It is known as the "Mango Capital of India" as mangoes are cultivated as the main crop, and the land here is extremely fertile with rich access to fresh water making it amenable to growing crops [3-5]. The only drawback of the fruit is its short shelf life and they are prone to significant post-harvest losses. The loss estimated was roughly about 35% at several phases, including farm level, transportation, marketing, storage, retail, processing unit, and consumer level [6]. Since there is a big need for domestic consumption as well as export, technologies to improve mango production, postharvest life, and market distribution are the need of the hour.

The majority of fruits develop some type of post-harvest "disease" that quickens the process of decay. As a result, minimizing membrane damage can result in increased post-harvest shelf life. Phospholipase D (PLD), a key enzyme discovered at the University of Guelph, is responsible for the onset of membrane deterioration. Hexanal, a key natural product, can significantly inhibit this specific action of PLD. Hexanal (molecular formula C_6 $H_{12}O$) is a strong inhibitor of the activity of the phospholipase-D enzyme, which slows down ethylene-stimulated ripening processes [6]. Phospholipase D is an enzyme that plays an important role in membrane deterioration during fruit ripening and senescence.

Based on these discoveries, the Enhanced Freshness Formulation (EFF), a spray formulation containing hexanal as the active ingredient, was created and tested on numerous fruit crops as a pre-harvest spray and a post-harvest dip treatment. Pre-harvest spray at 2% EFF on 15^{th} and 30^{th} day before harvesting ensures an extended shelf- life of fruits in ambient (2-3 weeks) and cold (4-6 weeks) storage, delayed harvest which improves better price (up to 40% more) in the market, 50% reduction in fungal disease incidence on fruits and additional net yield. Fruits that have been stored and handled are gleaming and hard, enabling long-distance shipping and export. Post-harvest dipping EFF (2%) for 5 mins & shade dried for 30 minutes extended the shelf-life of 13 – 15 days under ambient storage conditions. It also ensures the increased availability of nutrient-rich fruits, enhances food security, and significantly improves the economic returns for the farmers [7,8].

The objective of the study is about the perception of mango growers towards EFF technology. The farmers' acceptance of EFF technology may be a sign of rational decision-making based on their assessments of the technology's merits and appropriateness going forward. Farmers' perceptions of EFF technology are influenced by their needs and experiences, which influence their attitudes towards innovation. Farmers' perceptions changes as new information or knowledge become available. Understanding farmers' perceptions in the adoption process are critical for EFF promoters to anticipate real adoption challenges and identify a priori effective means of overcoming them.

2. RESEARCH METHODOLOGY

In the present study, an ex-post-facto research design was adopted. The study was conducted in Krishnagiri district. In this district, four blocks namely Krishnagiri, Kaveripattinam, Mathur, and Bargur were purposively selected because maximum number of farmers who had adopted EFF technology. The list of EFF technology adopted by mango growers has been collected from the Department of Nano Science and Technology at Tamil Nadu Agricultural University. Based on the list, irrespective of villages the data has been collected from 120 mango growers out of 400, who adopted EFF technology by using a simple random sampling method. The pretested and well-structured

interview schedule was used to collect the data for the study by personal interview. Descriptive statistics were used to analyze the perception of farmers towards EFF technology. Perception scale includes fourteen aspects of EFF technology on fruit characteristics.

3. RESULTS AND DISCUSSION

Table 1. Perception of mango growers towards EFF technology (n=120)

S.No.	Particulars	Extent of Perception					Mean	Rank
		Very low (1)	Low (2)	Medium (3)	High (4)	Very high (5)		
1.	Enhancing uniform ripening	0	5	20	20	75	4.375	II
2.	Enhancing colour intensity	0	1	31	65	23	3.916	V
3.	Enhancing fruit freshness	2	7	27	27	57	4.083	III
4.	Enhancing shelf life/longevity	0	0	10	22	88	4.608	I
5.	Enhancing endurance	0	7	23	68	22	3.875	VI
6.	Enhancing consumer appeal	9	10	43	31	27	3.475	IX
7.	Ensuring stable supply	0	12	43	40	25	3.65	VIII
8.	Enhancing market access	5	31	44	28	12	3.091	XI
9.	Possibility of adverse health	45	66	9	0	0	1.7	XIV
10.	Possibility of harm to environment	33	82	1	4	0	1.8	XIII
11.	Easy of application	2	6	21	58	33	3.95	IV
12.	Easy of formulation	3	7	47	32	31	3.675	VII
13.	Affordability	8	2	77	20	13	3.233	X
14.	Availability to potential users	4	30	72	9	5	2.84	XII

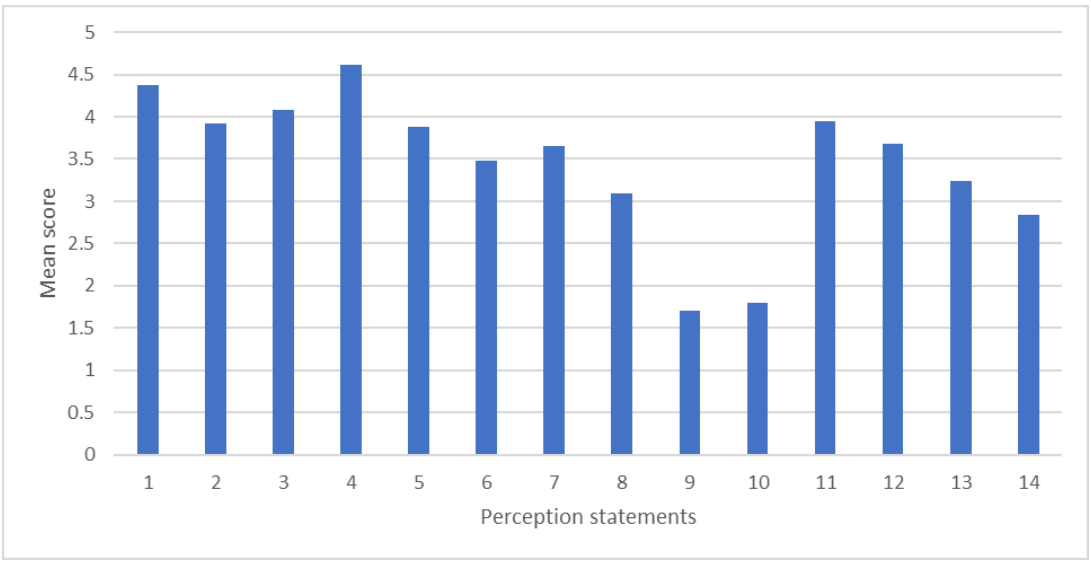

Fig. 1. Perception of mango growers towards EFF technology

Table 1 showed that farmers' perceptions of EFF technology included 14 aspects of consideration. Most of the farmers had the same perception that the EFF technology can enhance the shelf life or longevity of fruits with a score of 4.608. Because spraying the trees with EFF on 30th and 15th day before harvest, the stalk of the fruit gets stronger and it doesn't come off easily. So the shelf life gets extended by an average of 12 days and after harvest, dipping the fruits at 2% EFF for 5 minutes and shade drying for 30 minutes extended the shelf-life for 13-15 days under ambient storage conditions.

The second most perceived attribute of the farmers is that the EFF technology can increase the uniform ripening of fruits with a score of 4.375. Nowadays, the lack of easier and more rapid methods for uniform ripening poses a major problem for the fruit industry and farmers. Almost all methods of ripening, either conventional or modern chemical methods, come with their own merits and demerits. But farmers feel confident that EFF technology can increase the uniform ripening of their mangoes [9-11]. Uniform ripening leads to less labour cost and get a better price at a time.

The third ranking attribute is that EFF technology can enhance fruit freshness with a score of 4.083. Using the hexanal formulation of EFF technology on mango fruits' surfaces was found to have a profound effect to make the fruit fresher. At the point of purchase, the consumer uses appearance factors to indicate freshness and flavour quality. Additionally delayed harvest of the mangoes, EFF keeps the fruits fresher for 2 weeks which assists in additional income due to late arrivals in the market followed by the perception is that EFF technology can be easy to apply with a score of 3.95 and the EFF technology can increase colour intensity (attractiveness) with a score of 3.916. Colour and appearance attract the consumer to the mangoes and can help in impulse purchases. The external appearance of whole fruit is used as an indicator of ripeness, although it can be a misleading one [12]. Glossiness on the outside of whole fruits tends to be a desirable attribute for whole fruits.

The other perceptions of mango growers towards EFF technology are enhancing endurance (3.875), easy of formulation (3.675), ensuring stable supply (3.65), enhancing consumer appeal (3.475), affordability (3.233), enhancing market access (3.091), availability to potential users (2.84). Minimal negative environmental repercussions and adverse health with the score of 1.8 and 1.7 respectively. Hexanal formulation of EFF technology, a plant-produced GRAS (Generally Regarded As Safe) molecule, has been shown by University of Guelph researchers and also no known or observed ill effect on the environment [6]. Further due to its volatile nature, the product evaporates within 24 hours leaving no trace in fruits as well as gets broken down quickly into basic molecules in the atmosphere.

The results revealed that in addition to the anticipated extension of post-harvest shelf life, fruits in the treated trees were also retained for an additional period. These results made a significant impact on the mango growers who used EFF technology, as they could generate a 10-15% additional income.

4. CONCLUSION

Nanotechnology is becoming increasingly essential in the food industry, particularly for the preservation and packaging of fruits and vegetables. Preventing post-harvest losses will boost the availability of nutrient-rich fruits while also improving food security. Nowadays many technologies have been introduced to improve agricultural production, productivity, post-harvest handling methods, market access, and high farm income. EFF technology is considered vital in enhancing fruit quality and prolonging shelf life. These twin benefits can allow farmers to sell fruits in niche and high-value markets and reduce postharvest losses that are estimated to be as high as 30%**.** According to this survey, potential EFF users place a higher value on shelf-life followed by uniform ripening, color intensity (attractiveness), fruit freshness, ease of application, endurance, and finally minimal negative health and environmental repercussions. This EFF technology increases domestic consumption as well as the export of mangoes. Large domestic production base, relatively long period of availability (March to August), diversity of the varieties, economic liberalization, and priority to the export of fresh products have opened up the possibility of boosting 109 Mango exports from India.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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