GUAVA FRUIT RIPENING PROCESS WITH ETHEPHON AND RELATED CHEMICALS: A REVIEW

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Abstract

Today, wide rational sources have been offered by current research on ethylene gas and related sources, for explaining influence of applied (exogenously) chemicals including different plant growth regulators (PGRs). In this respected, it is described widely that ethephon encourages ripening process and increases level of ethylene in plant cells which promote usual ripening processes in fruits and may influence storage fruit quality and adjourn harvesting process. Ministry of Agriculture has explained that various fruits when subjected to exogenously ethylene at lower concentration stimulate ripening activity and declared as safe (ranging from 0.001-0.01%) for human consumption. Exogenous application of various chemicals expressively declined disease incidence especially post-harvest, consequently increased fruit quality including shelf life of the fruit. Among these chemicals, the ethrel has been recognized for better results. It is established that pre and post treatment with various chemicals to bearing trees and fruits may lead to useful results. But in both cases, results may vary. From collected literature It is reviewed that these ripening substance influence harvesting process, date and monetary revenue generated by a grower by making effective selling strategy.

Key words: Ethylene gas and sources; Lower concentration; Fruit quality; Ripening process

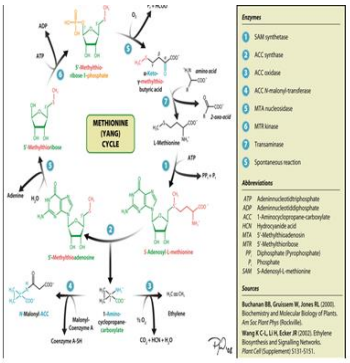
INTRODUCTION

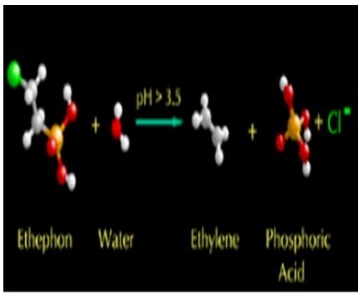
Fruit ripening is a natural process in which a fruit goes through various physical and chemical changes and gradually becomes sweet, colored, soft, and palatable. Fruit ripening process can also be stimulated by applying artificial fruit ripening agents. Fruit ripening process has been considered as a scientific activity which includes the biochemistry and physiology are supposed to affect the outer aspect, texture, aroma, and flavor in the fruits (Giovannoni, 2004). Ethylene, also known as ripening hormone, controls several many aspects of metabolism processes at cell and tissue level and commencement of development ripening and senescence, mostly in

climacteric natured fruits. Important source of ethylene, ethrel, breaks down itself and consequently there is production of ethylene and the same has been proved to accomplish the ripening process in fruits. It has been described that ethylene evolved from the ethrel, was highly effective in initiating ripening process than dipping application of fruits in ethrel solution (Prasanna et al., 2007). Ethrel, a source of ethylene gas, may lead to ripening of fruits 2-6 days earlier when treated under immersed conditions. At the same time if ethylene, released from ethrel solution, is used this ripening time is 6-9 days earlier than normal time (Nour and Goukh, 2010). During maturity process many visible changes occur in fruits and the same is known as maturity index. These changes may include variation in composition of carbohydrate, enrichment of sugary materials, colour changes, fruit firmness and ester development (responsible for flavor and aroma etc.).

Review of Literature-

Presently various plant growth regulators NAA, GA3, salicylic acid and ethephon, are consider for their important role in different plant processes like as flower induction, fruit set, fruit growth and development, improvement in yield and quality of the same. Lot of research work has been done to justify the role of PGR for the betterment of fruit the quality and quantity in various fruit crops (Amilkar *et al.,* 2006 in citrus plants, Tripathi and Shukla 2006 in Strawberry and Singh *et al.,* 2007 in aonla). Lal *et al.* (2013) reported that the fruit weight was expressively influenced and change in the length and girth by the application of ethrel (100 ppm) in cv. Allahabad Safeda. Nour and Goukh, (2010) reported the effect of ethrel at 250, 500 and1000 ppm concentration on pink-fleshed guava fruit ripening and concluded that ripening was progressively enhanced when the concentration of ethrel was increased. Fruits dipped in solution of Ethrel were less affected in increasing fruit ripening then ethylene released from ethrel. The effect of ethrel on ripening was indicated by increased peel color, increased TSS, decreased flesh firmness. Pandey et al., (2016) reported that the Respiration is a process of breakdown of complex material in cells to simpler molecules giving energy and some specific molecules which are used in different cellular reactions. Thus, respiration is a good indicator of cellular metabolic activity, and respiratory pattern is characteristic of the stages in the life cycle of a fruit such as development, ripening, and Senescence. Pathak *et al*., (2018) resulted that the climacteric fruits are referred to as ethylene dependent fruits and they have the capability to ripen after the harvest, often with the help of exogenous ethylene. However, it is generally claimed that non-climacteric fruits ripen only if they remain attached to the parent plant. Hiremath et al., (2017) resulted that a Sardar variety of guava showed significantly decreased vegetative growth after the ethrel treatment. Reduced plant height was recorded at 120 days after transplanting. The concentration of ethrel was 500 ppm during treatment. Shakila et al., (2017) experimented with the ethrel on the quality of guava. The TSS increased under the treatment of ethrel. Under 500 ppm and 1000 ppm quality of fruit was increased than application @ 1000 ppm. When concentration was raised then TSS value has increased along with ascorbic acid. Gollag et al., (2019) reported that guava is grown in tropical and subtropical regions of the World and in India production of guava is low, compared to other countries and they also stated that if the concentration of ethrel is progressively increased, increased flowering is recorded on the tree.





Ethylene and Fruit Ripening

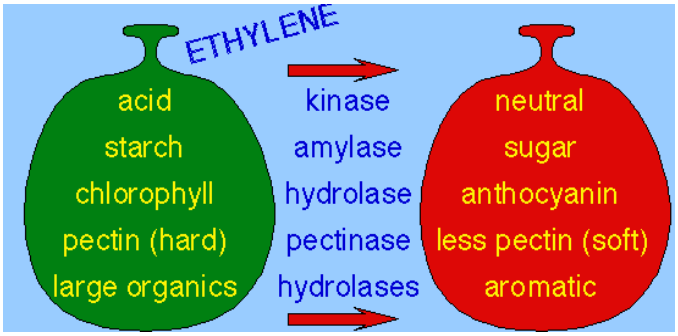


Fig. – Ethylene action

Elkashif et al., (2016) described that guava is most popular fruit in Sudan and usually harvested at the mature green stage and treated with ethrel. They observed that the effect of ethrel on total soluble solids of fruits during storage that firstly TSS content showed increased trend and with passage of time, it was declined and after 6 days, they again found high TSS content, which is highest during storage life, ethrel affected the vitamin C content was significantly increased with the enhancement of ripening rate. Bhardwaj et al., (2005) reported that guava is also considered as the apple of tropics in India. The cultivation of guava fruit since the early 17th century but now it is most common fruit in India. They proved that ethrel 1000 ppm and 2000 ppm may be used to decrease plant canopy. Das et al., (2011) dipped fruits of mango of cultivar Alphonso in ethrel solution of 750 ppm concentration and evidenced early ripening as compare to controlled ones and quantity of ascorbic acid was also improved. Jain et al., (2017) explained that demand of guava fruit is increasing and its cultivation at commercial level day by day. Different concentrations of ethrel were used (250 ppm and 500 ppm) as a plant growth regulator on guava during winter season. Ethrel increased the fruit set per cent and decreased harvesting duration (117-115) along with increase in yield per hectare. Lal and Das (2017) described that major problem in Assam is low yield and poor quality of guava fruit. Generally, guava has three lowering seasons under North Indian condition while in Assam state, they reported that the two flowering seasons under prevailing climate conditions. They evaluated high TSS content (9.90) high at 50 ppm concentration of ethrel. Maximum acidity (0.30) was recorded at ethrel 100 ppm while the lowest acidity (0.27) was found at 50 ppm concentration. The maximum yield (26.50kg/plant) was recorded with ethrel 100 ppm concentration in guava. Singh et al., (2018) revealed that pre or post-treatment with various chemicals may often lead to various kinds of effects in the stored fruit but at the same time if a similar compound is applied to bearing fruiting tree, it may lead to variable

results. Katiyar et al., (2009) described that guava is hardly in nature, so it's survived under all conduction. They have sprayed GA_3 150 ppm, ethrel 250 ppm and NAA 100 ppm all three-regulator including their combination, four times in guava crop, first spray was on the flowering initiation, the second spray was one week after first spray and third and fourth spray at fruit setting stage. The combination of urea 2% and ethrel 150 ppm effect on guava crops lead to good results and it was observed that maximum fruit weight (190.26g), increase in yield (86.29kg/plant), maximum TSS (12.56^o Brix), Titrable acidity is less (0.30%) and Total sugar percent (11.82), in this treatment. Ethylene effect on physiological loss of orange fruit was accessed and orange fruits were exposed to 150 ppm concentration in ripening chamber. Highest loss in weight was recorded in ethephon 1000 ppm followed by 750 ppm concentration. All these various treatments lead fruit to shriveled and excess of softening and ripening was also enhanced. It is concluded that ethephon (500 ppm) while ethylene gas (100 ppm) caused optimum ripening of orange. Lowest PLW was recorded in control treatment (Chauhan *et al.*, 2012). Brar et al., (2012) recorded maximum total soluble solids in guava fruits of winter season cv. Allahabad Safeda, by treating with ethephon @1000 ppm and results were trailed with ethephon @ 500 ppm. Deepa and Preetha (2014) observed that the ethrel gave rise to ethylene gas which is used for ripening in mango fruit and various concentrations of ethylene are used during course of study. They observed that the ripening rate was increased at high concentration of ethylene. The fruit ripening was indicated by the change in peel color, total soluble solid increase and decrease in fruit firmness of the fruit. Gill et al., (2015) recorded that the mango ripening was induced by ethephon and its peel value was greatly increased. The maximum mango fruit peel value recorded when they were treated with 1000 ppm and 800 ppm ethephon. In mango fruit more yellowish color was appeared when we use a high concentration of ethephon 800 ppm and less yellowish color appears when concentration was 200 ppm. Venkatram and Pandiarajan (2014) conducted experimental study to check the effect of different concentrations of ethylene on mango fruit in a wooden chamber (including TSS, PLW, and color). Various concentration and duration of treatment like 400, 500 and 600 ppm and 15,20 and 25 hours of ethylene were used. It was concluded that 500 ppm gave the better result because the mango fruit ripening in 24 hours. Nair & Singh (2013) dipped mango in the ethrel solution whose concentration was 50, 250 and 500 mg/liter. They concluded that as concentration of ethrel was increased, increase in mango (cv Kensington) fruit including fruit firmness, improved taste and total soluble solid, was noted. Abbas et al., (2002) accessed the effect of ethephon in jujube fruit. The ethephon were affected the total soluble solids and acid content including other characters of the fruit. Use of ethephon 500 ppm in jujube fruit caused to lead increased TSS (total soluble solids), ascorbic acid content while titrable acidity was decreased. Mohamed et al., (2003) submitted in mango fruit that ripening can be enhanced with the help of ethylene gas. During research studies different concentrations of ethylene gas (250, 500 and 1000 ppm) was used. It was concluded that as the concentration of ethylene was inclined, the rate of ripening rate was also increased. Fruit surface color along with total soluble solid were improved while flesh firmness was decreased. Yadav *et al.*, (2001) accessed the impact of foliar treatment of PGR like NAA, GA and ethrel (ethephon) on guava trees cv. 'L-49' and revealed that TSS (total soluble solids and ascorbic acid was found to be maximum with application of NAA 60 ppm.

However, all plant growth regulators (PGRs) expressively increased total sugars over control treatment. Bhosale (2012) treated ber cv. Mehrun trees with 2,4- D, GA3 and ethephon at Junagadh. He described that among different treatment of GA3, 20 ppm concentration lead to best and highest net realization along with cost benefit ratio (1:2.9). Singh *et al*. (1996) sprayed GA3 and Ethrel (Ethephon) on mango cv. Amrapali in the June to enhance the ripening process and advancement of the storage life of Amrapali mango fruits. GA3 application @75 and 50 ppm gave better results regarding quality of fruits. Madhavi *et al.* (2005) submitted that when sapota fruits cv. Pala were applied with various levels of ethrel (500 ppm, 1000 ppm, 2000 ppm and 3000 ppm), placed in polythene bags (1.2 % ventilation). It was concluded that sapota fruits of treatment ethrel@ 1000 ppm gave much better results as compare to other treatments. Stover *et al.,* (2003) concluded that application of ethephon @ 150 mg/liter along with plant growth regulator i.e. NAA @ 10 mg/liter enhanced ripening process and harvest date before occurrence of significant fruit drop in apples cv. Mcintosh. Jain and Dashora (2007) submitted application of ethrel @ 200ppm in guava cv. Sardar, with took much less days for commencement of blossoming but maximum number of flowers. Furthermore, Shaban and Haseeb (2007) recognized that application of 600 ppm of ethephon gave lowest average value of shoot length. They recorded that ethephon @ 600 ppm resulted in emergence of new shoots (maximum in number) and produced regular index number of bud bursts. Gupta and Kaur (2007) recorded that ethrel treatment @ 100 ppm caused reduction in fruit drop per cent trailed by ethrel (50 ppm) in plum. Moreover, maximum fruit retention was also recorded in ethrel treatment (100 ppm). They observed the highest fruit weight and better yield of plum when ethrel was applied at @ 400ppm.

Rajput, (2008) carried out different research studies under conditions of Junagadh Agricultural University in guava fruits cv. L-49 and observed that all these treatments resulted in increased total sugars in guava fruits. Joshi *et al.* (2009) evaluated the effect of ethrel on on flowering and fruiting pomegranate. They concluded that ethrel (2 ml/lit.) took minimum time for commencement of blossoming and resulted in maximum number of flowers. Likewise, better number of fruits, fruit weight and improved were resulted due to the same concentration. Some authors claim that ethylene treatment is the best solution to avoid long term ripening of the fruit. It was shown that various kinds of ethylene applications enhanced quality including increase in sugars (fructose and sucrose content), TSS (total soluble solids), production of ethylene, respiration process along with sensory value. At the same time there is decrease in firmness and acidity. Bal and Kok (2006) described that both types of ethylene treatments including dipping into solution and fumigation, can cause ripening of unripe kiwifruits to edible maturity level. The rate of kiwifruit ripening is influenced by time and exogenous ethylene levels. Bal and Kok (2007) stated that ethephon with glycerin @ 1000 ppm had outstanding impact on ripening and improvement in other physical as well as quality characteristics of kiwifruit. Glycerin concentration ranging from 3 and 5 per cent, was most useful along with ethephon on kiwifruit tissues. Mahajan *et al* (2008) submitted that when harvested first lot of winter guava (*Psidium guajava)* cv. 'Allahabad Safeda' treated with ethylene gas @ 100 ppm for period of 24 hrs in a ripening chamber and second lot was applied with aqueous solution of ethephon @ 500, 750, 1000 ppm for 5 min. After treatment fruits were packed in

CFB (corrugated fiber board) cartons and placed in ripening compartment at temperature of 20 ± 1oC with 90-95% RH. It was concluded that ethephon solution or ethylene gas (1000 ppm) lead to improved ripening of winter guava fruits with pleasant flavour, uniform colour, optimum firmness and desired sensory quality. Control treatment resulted in ripening, with poor quality characteristics. Park *et al* (2006) determined that application of ethylene to kiwifruits results in noteworthy decrease in the firmness during early stage of ripening and increase in free sugars, sensory value, TSS (total soluble solids), ethylene biosynthesis, total polyphenols and antioxidant activity. Mahajan *et al* (2010) stated that ethylene gas concentration @ 100 ppm lead to optimum ripening of banana with even colour, desirable flavour, firmness and improved quality and enhanced shelf life. They further described that ethephon application @ 500 ppm lead to optimum ripening of banana after 4 days with pleasant flavor, firmness, uniform colour, and acceptable quality. Gill & Bal, (2010) revealed at KVK, Hoshiarpur that ethephon application in winter guava resulted in increase on vitamin c content. Mandal *et al* (2008) concluded that treatment with ethrel (ethephon 39%) @ 1.5 ml / litre on harvested tomatoes improved fruit quality along with levels of carotene and lycopene.

Conclusion

Ripened and physico-chemical characters are important parameters during marketing process, which decide the fate of the grower. Presently, these characters are encouraged by using various ripening substances. Today, ethylene gas is widely accepted agent for this purpose which alters softening and color of the fruit including quality traits. Furthermore, this gas is responsible for fastening ripening process but also affects the quality parameters of the fruits. Supplementary ethylene is also known for various influences like loss of chlorophyll and bending/shortening of the stems etc. Lot of research work has been accomplished by developing sophisticated technologies in genomic and proteomics. These techniques give deep insights by which ethylene governs ripening process in various fruit plants.

Acknowledgements

The authors acknowledge the Lovely Professional University, Jallandhar, Punjab for providing the required services for successful completion of review work.

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