JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 07, ISSUE 16, 2020

ISOLATION OF TARTARIC ACID FROM NATURAL FRUITS

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ABSTRACT :- In the present work I have pick two phytochemicals i.e. Potassium bitartrate and tarataric acid extracted from tamarind, grapes, and mango.
First raw materials were collected and dried. This dried raw materials were used for isolation of potassium bitartrate and tarataric acid. On dried extracts various confirmatory tests were performed.
From the present performed work it was found that tamarind gave more quantities of potassium bitartrate and tarataric acid as compare to mango and grapes.
This research can implement further to get more amount of acid with this modified large scale instead of using expensive chemicals and rare equipments.
KEYWORDS :- Tartaric acid, Extraction, Neutralization, Synthesis.

INTRODUCTION :-

Tartaric acid was first isolated from potassium tartrate, known to the ancients as tartar, during 800 AD by the alchemist Jabir ibn Hayyan .The modern process was developed in 1769 by the Swedish chemist Carl Wilhelm Scheele.
Tartaric acid is an organic di-carboxylic compound. Its molecular formula is $C_4H_4O_6$. It is also known as racemic acid. It contains two stereocentres. Its IUPAC name is 2,3-dihydroxybutanedioic acid. It is acidic in nature. Tartaric acid found in many fruits like grapes, tamarinds, banana, and citrus fruits.
Tartaric acid**,** also called dihydroxybutanedioic acid, a dicarboxylic acid, one of the most widely distributed of plant acids, with a number of food and industrial uses. Along with several of its salts, cream of tartar (potassium hydrogen tartrate) and Rochelle salt (potassium sodium tartrate), it is obtained from by-products of wine fermentation. In a partially purified form, tartar was known to the ancient Greeks and Romans; the free acid was first isolated in 1769 by Swedish chemist Carl Wilhelm Scheele. The lees, or sediments, and other waste products from fermentation are heated and neutralized with calcium hydroxide; the precipitated calcium tartrate is then treated with sulfuric acid to produce free tartaric acid. Rochelle salt is prepared from the crude crystalline potassium acid salt, called argol, by neutralization with sodium carbonate. Purified cream of tartar comes chiefly from the filtrates from production of the acid and Rochelle salt. A third salt, tartar emetic (antimony potassium tartrate), is made from the potassium acid salt and antimony oxide[1].

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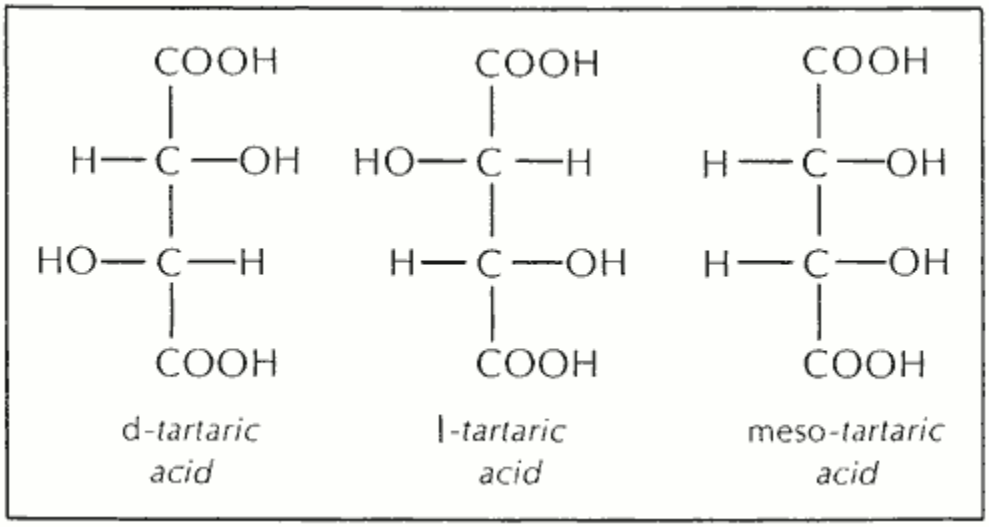
Three stereoisomeric forms of tartaric acid exist: (1) dextrorotatory tartaric acid (D-tartaric acid) found in grapes and several other fruits, (2) levorotatory tartaric acid (L-tartaric acid) obtained chiefly by resolution of racemic tartaric acid, and (3) a meso or achiral form. Racemic tartaric acid (an equal mixture of D- and L-tartaric acid) is prepared commercially by the molybdenum- or tungsten-catalyzed oxidation of maleic anhydride with hydrogen peroxide.



Study of the crystallographic, chemical, and optical properties of the tartaric acids by French chemist and microbiologist Louis Pasteur laid the basis for modern ideas of stereoisomerism.
The various tartaric acids and the common tartrate salts are all colourless, crystalline solids readily soluble in water. Tartaric acid is widely used as an acidulant in carbonated drinks, effervescent tablets, gelatin desserts, and fruit jellies. It has many industrial applications—e.g., in cleaning and polishing metals, in calico printing, in wool dyeing, and in certain photographic printing and development processes. Rochelle salt is used in silvering mirrors, in processing cheese, and in compounding mild cathartics. Cream of tartar is incorporated into baking powders, hard candies, and taffies; and it is employed in the cleaning of brass, the electrolytic tinning of iron and steel, and the coating of other metals with gold and silver. Tartar emetic is used as an insecticide and a dyeing mordant[2].

Tartaric acid is found in cream of tartar, which is used in making candies and frostings for cakes. Tartaric acid is also used in baking powder where it serves as the source of acid that reacts with sodium bicarbonate (baking soda). This reaction produces carbon dioxide gas and lets products "rise," but it does so without the "yeast" taste that can result from using active yeast cultures as a source of the carbon dioxide gas.

Tartaric acid is used in silvering mirrors, tanning leather, and in the making of Rochelle Salt, which is sometimes used as a laxative. Blue prints are made with ferric tartarte as the source of the blue ink.

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In medical analysis, tartaric acid is used to make solutions for the determination of glucose. Common esters of tartaric acid are diethyl tartarate and dibutyl tartrate. Both are made by reacting tartaric acid with the appropriate alcohol, ethanol or n-butanol. In the reaction the Hydrogen of the COOH acid group is replaced with an ethyl group (diethyl tartarate) or butyl group (dibutyl tartarate. These esters are used in manufacturing lacquer and in dyeing textiles

Tartaric acid is one of the least antimicrobial of the organic acids known to inactivate fewer microorganisms and inhibit less microbial growth in comparison with most other organic acids (including acetic, ascorbic, benzoic, citric, formic, fumaric, lactic, levulinic, malic, and propionic acids) in the published scientific literature.

Tartaric acid and its derivatives have a plethora of uses in the field of pharmaceuticals. For example, it has been used in the production of effervescent salts, in combination with citric acid, to improve the taste of oral medications. The potassium antimonyl derivative of the acid known as tartar emetic is included, in small doses, in cough syrup as an expectorant[3].

Tartaric acid also has several applications for industrial use. The acid has been observed to chelate metal ions such as calcium and magnesium. Therefore, the acid has served in the farming and metal industries as a chelating agent for complexing micronutrients in soil fertilizer and for cleaning metal surfaces consisting of aluminium, copper, iron, and alloys of these metals, respectively.

PREPARATION :-

• Tartaric acid is a white crystalline diprotic aldaric acid.

• It occurs naturally in many plants, particularly grapes, bananas, and tamarinds, is commonly combined with baking soda to function as a leavening agent in recipes, and is one of the main acids found in wine.

• It is added to other foods to give a sour taste, and is used as an antioxidant.

• Salts of tartaric acid are known as tartrates. It is a dihydroxyl derivative of succinic acid.

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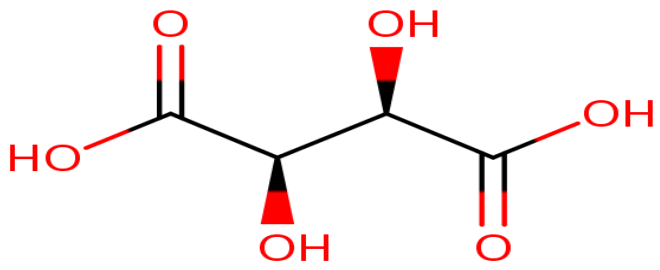

2,3-dihydroxybutanedioic acid

DERIVATIVES[4] :-

- Important derivatives of tartaric acid include its salts, cream of tartar (potassium bitartrate), Rochelle salt (potassium sodium tartrate, a mild laxative), and tartar emetic (antimony potassium tartrate).
- Diisopropyl tartrate is used as a catalyst in asymmetric synthesis.
- Tartaric acid may be most immediately recognizable to wine drinkers as the source of "wine diamonds", the small potassium bitartrate crystals that sometimes form spontaneously on the cork .

PHYSICAL PROPERTIES :-

• Tartaric acid appears as small white crystals when it is in its solid form.
• There is no odor to tartaric acid, but inhalation may cause coughing and sneezing.
• The solid form melts to a liquid at 403 degrees Fahrenheit (206 degrees Celsius).

CHEMICAL PROPERTIES :-

- Some of the names for tartaric acid used in chemistry include 2,3-dihydroxysuccinic acid, uric acid, and paratartaric acid.
- The basic molecular formula for the acid is C4H606.
- This property gives it the ability to rotate polarized light.
- This light rotation does not occur in one form of tartaric acid called DL-tartaric acid.
- A large amount of tartaric acid (around 500 grams) would be lethal to a human being.

CHARACTERSTIC PROPERTIES :-

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- Molecular formula :- C4H6O6
- Molecular weight :- 150.08 g/mol
- Colour :- White granular to crystalline form
- Odour :- Odourless compound
- Taste :- Acidulous taste
- Melting point :-275 ^{0} C
- Boiling point :- 174^0 C
- Density :- 1.79 g/mol

USES OF TARTARIC ACID[5] :-

- Tartaric acid, also called 2,3-dihydroxybutanedioc acid, crystallizes from solution as transparent, monoclinic prisms.
- It is present in many fruits, such as grapes, tamarinds, bananas, pineapples and mulberries. It is a by product in the manufacture of wine.
- Tartaric acid is useful in some baking powders, in forming silver mirrors, in lacquers, as a flavouring agent, and in specialty electroplating baths. It is used to improve the taste of oral medications
- It is used to chelate metal ions such as magnesium and calcium
- It is used in recipes as a leavening agent along with baking soda
- It is used as an antioxidant.
- It is as one of the important acids in wine.
- It is used in foods to give a sour taste.
- It is sometimes used to induce vomiting.
- It is used to make silver mirrors.
- In its ester form, it is used in the dyeing of textiles.
- It is used in the tanning of leather.
- It is used in candies.
- In its cream form, it is used as a stabilizer in food.

HEALTH BENEFITS :-

- While tartaric acid is readily used by many different industries for a plethora of reasons, it is also lauded for its health benefits.
- More specified uses of the acid include improving glucose tolerance and lowering overall glucose levels proving itself useful for individuals sensitive to glucose.
- Finally, tartaric acid is said to aid digestion as it helps to improve intestinal absorption.
- This is said to dramatically increase the rate at which quality nutrients are absorbed into the bloodstream from consumed foods.
- The acid is lauded with antioxidant and anti-inflammatory properties that keep the immune system healthy.

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- Tartaric acid aids digestion, improving intestinal functions.
- It improves glucose tolerance and also improves intestinal absorption.
- Only consume in moderation since over consumption can lead to gastric inflammation

NUTRITIONAL VALUE :-

- The acid is lauded with antioxidant and anti-inflammatory properties that keep the immune system healthy.
- Tartaric acid aids digestion, improving intestinal functions.
- It improves glucose tolerance and also improves intestinal absorption.
- Only consume in moderation since over consumption can lead to gastric problems.

PLAN OF WORK :-

- Collection of fruits for the synthesis of tartaric acid . (Tamarind, Grapes, Mango)
- Isolation of fruits
- Different methods use for the isolation of tartaric acid.

1) Extraction Process

2) D-dibenzoyl tartaric acid method

3) General test :-

- Preparation of sample solution
- Neutralisation of sample
- Calcium Chloride test

4) Confirmator test :-

- Deniges test
- Fentons test

OBJECTIVE :-

This research can implement further to get more amount of acid with this modified process in large scale instead of using expensive chemicals and rare equipments.

INFORMATION OF FRUITS :-

1) TAMARIND :-

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Fig.1 Tamarind

Scientific classification :-

- Kingdom: Plantae
- Clade: Tracheophytes
- Clade: Angiosperms
- Clade: Rosids
- Order: Fabales
- Family: Fabaceae
- Subfamily: Detarioideae
- Tribe: Amherstieae
- Genus: Tamarindus L.
- Species: T. indica

Binomial name :-

- Tamarindus indica

Synonyms :-

- Cavaraea Speg.
- Cavaraea elegans Speg.
- Tamarindus erythraeus Mattei.
- Tamarindus occidentalis Gaertn.
- Tamarindus officinalis Hook.
- Tamarindus somalensis Matteqi .
- Tamarindus umbrosa Salisb.

The fruit is an indehiscent legume, sometimes called a pod, 12 to 15 cm (4+1⁄2 to 6 in) in length, with a hard, brown shell.

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The fruit has a fleshy, juicy, acidic pulp. It is mature when the flesh is coloured brown or reddish brown. The tamarinds of Asia have longer pods (containing six to 12 seeds), whereas African and West Indian varieties have shorter pods (containing one to six seeds). The seeds are somewhat flattened, and a glossy brown. The fruit is best described as sweet and sour in taste, and is high in tartaric acid, sugar, B vitamins, and, unusually for a fruit, calcium.

The fruit is harvested by pulling the pod from its stalk. A mature tree may be capable of producing up to 175 kg (386 lb) of fruit per year. Veneer grafting, shield (T or inverted T) budding, and air layering may be used to propagate desirable cultivars. Such trees will usually fruit within three to four years if provided optimum growing conditions[6].

Abstract Tamarind a naturally obtained, long lived, evergreen and less expensive raw material. It comprises organic acids like high content of tartaric acid 12-18%, malic acid, citric acid and byproducts like pectin, potassium Bitartrate.

CONSTITUENT OF TAMARIND :-

Contents	Per 120 g of tamarind fruit pulp	Per 100 g of turmeric powder	Per 100 g of tomato fruit	Units
Water	37.68	12.85	94.52	g
Energy	287	312	18	kcal
Protein	3.36	9.68	0.88	g
Total lipid (fat)	0.72	3.25	0.2	g
Ash	3.24	1.32	0.5	g
Carbohydrate	75	67.14	3.89	g
Fiber, total dietary	6.1	22.7	1.2	g
Sugars, total	46.56	3.21	3.62	g
Minerals				
Calcium	89	168	10	mg
Iron	3.36	55	0.27	mg
Magnesium	110	208	11	mg
Phosphorus	136	299	24	mg
Potassium	754	2080	237	mg
Sodium	34	27	5	mg
Zinc	0.12	4.5	0.17	mg
Copper	0.103	-	0.059	mg
Vitamins				
Vitamin C, total ascorbic acid	4.2	0.7	13.7	mg
Thiamin	0.514	0.058	0.037	mg
Riboflavin	0.182	0.15	0.019	mg
Niacin	2.326	1.35	0.594	mg
Pantothenic acid	0.172	-	0.089	mg
Vitamin B-6	0.079	0.107	0.08	mg
Folate, total	17	-	15	µg
Vitamin A, IU	36	-	833	IU
Vitamin E (alpha-tocopherol)	0.12	4.43	0.54	mg
Vitamin K (phylloquinone)	3.4	13.4	7.9	µg
Lipids				
Fatty acids, total saturated	0.326	1.838	0.028	g
Fatty acids, total monounsaturated	0.217	0.449	0.031	g
Fatty acids, total polyunsaturated	0.071	0.756	0.083	g

Table. No 1 Costituents of Tamarind.

Health Benefits Of Tamarind[7] :-

- A rich source of antioxidants.
- May have anticancer properties.
- May improve heart health and cholesterol.
- Offers liver protective benefits.
- Provides natural antimicrobial benefits.
- May offer anti-diabetic effects.

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2) GRAPES :-

Fig.2 grapes.

Scientific classification :-

- Kingdom :- Plantae
- Division :- Magnoliophyta
- Class :- Magnoliopsida
- Order :- Vitales
- Family :- Vitaceae
- Genus :- Vitis
- Species :- Vitis vinifera

Binomial Name :-

- Vitis vinifera

Synonyms :-

- grapevine.
- grape vine.
- vinifera grape.
- wine.
- slipskin grape.
- vino.
- bullace grape.

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- edible fruit.

Grape is the common name for any of the woody, vining plants belonging to the about 60 species comprising the genus Vitis in the flowering plant family Vitaceae. It is also the name for the edible fruit that grows on these perennial and deciduous plants. Some consider grape a common term for all members of the family Vitaceae.

The fruits (grapes) can be eaten raw or used for making jam, grape juice, jelly, wine, and grape seed oil. The widely cultivated Vitis vinifera, the common grape vine, which is native to the Mediterranean region, central Europe, and southwestern Asia, is one of the oldest cultivated plants, with records to 4000 B.C.E. in Egypt (Bender and Bender 2005), and it is frequently mentioned in the Bible. Human creativity is apparent in the numerous cultivars of grapes created by people, as well as the many uses of the fruit that have been invented[8].

Grapes not only provide commercial, aesthetic, and nutritional values for humans but also benefit the ecosystem by serving as food for various insects and birds.

Grape is a fruit, botanically a berry, of the deciduous woody vines of the flowering plant genus Vitis. Grapes can be eaten fresh as table grapes, used for making wine, jam, grape juice, jelly, grape seed extract, vinegar, and grape seed oil, or dried as raisins, currants and sultanas.

The ranges of acid concentrations found in grapes were as follows: citric, 30–164 mg/l; tartaric, 4.98–7.48 g/l and malic, 1.43–3.40 g/l. Also the ranges of acid concentrations found in grape juices were as follows: citric, 31–181 mg/l, tartaric, 4.07–4.92 g/l and malic, 1.36–3.47 g/l.

CONSTITUENT OF GRAPES :-

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Manganese	0.661 mg
Selenium	0.184 μg
Boron[4]	0.748 mg
Vitamins	
Vitamin C (total ascorbic acid)	3.680 mg
Thiamine	0.085 mg
Riboflavin	0.052 mg
Niacin	0.276 mg
Pantothenic acid	0.022 mg
Vitamin B6	0.101 mg
Folate (total)	3.680 μg
Vitamin A (IU)	92.00 IU
Vitamin A (RAE)	4.600 μg RAE
Vitamin E	0.313 mg ATE
Lipids	
Fatty acids (total saturated)	0.105 g
14:0	0.003 g
16:0	0.090 g
18:0	0.012 g
Fatty acids (total monounsaturated)	0.013 g
18:1 (undifferentiated)	0.01 g
Fatty acids (total polyunsaturated)	0.094 g
18:2 (undifferentiated)	0.073 g
18:3 (undifferentiated)	0.022 g
Amino acids	

Table. No 2 Costituents of Grapes.

Benefits of Grapes :-

- Helps your immune system.
- Prevents cancer.
- Lowers blood pressure.

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- Protects against heart disease.
- Reduces high cholesterol.
- Protects against diabetes.
- Helps maintain brain health.
- Improves bone health.

3) MANGO :-

Fig.3 Mango

Scientific classification :-

- Kingdom: Plantaeia
- Phylum: Magnoliophyta
- Class: Magnoliopsida
- Order: Sapindales
- Family: Anacardiaceae
- Genus: Mangifera
- Species : Mangifera altissima

Binomial Name :-

- Mangifera indica

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Synonyms :-

- Mangifera.
- fruit tree.
- mango tree.
- Mangifera indica.

A mango is an edible stone fruit produced by the tropical tree Mangifera indica which is believed to have originated from the region between northwestern Myanmar, Bangladesh, and northeastern India M.
Indica has been cultivated in South and Southeast Asia since ancient times resulting in two distinct types of modern mango cultivars: the "Indian type" and the "Southeast Asian type". Other species in the genus Mangifera also produce edible fruits that are also called "mangoes", the majority of which are found in the Malesian ecoregion.

Worldwide, there are several hundred cultivars of mango. Depending on the cultivar, mango fruit varies in size, shape, sweetness, skin color, and flesh color which may be pale yellow, gold, green, or orange. Mango is the national fruit of India, Pakistan and the Philippines, while the mango tree is the national tree of Bangladesh[9].

During this study it has been observed that for mango which content 25% citric acid, 37.5% malic acid, and 37.5% tartaric acid has maintained the total soluble solid

CONSTITUENT OF MANGO :-

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Vitamin	Value per 100 g
Ascorbic acid (Vit C)	13.2–92.8 mg
Thiamine (Vit B1)	0.01–0.04 mg
Riboflavin (Vit B2)	0.02–0.07 mg
Niacin (Vit B3)	0.2–1.31 mg
Pantothenic acid (Vit B5)	0.16–0.24 mg
Pyridoxine (Vit B6)	0.05–0.16 mg
Folate total	20–69 µg
Folic acid	0 µg
Folate food	20–69 µg
B12	0.00 mg
Vitamin A	54 µg
Vitamin E (α-tocopherol)	0.79–1.02 mg
Vitamin K	4.2 µg

Table. No 3 Costituents of Mango.

Health Benefits of Mango :-

- Packed with nutrients.
- Low in calories.
- May help prevent diabetes.
- High in healthy plant compounds.
- Contains immune-boosting nutrients.
- Supports heart health.
- May improve digestive health.
- May support eye health.

MATERIAL AND METHODS :-

MATERIAL AND METHODS FOR FRUITS (TAMARIND, GRAPES, MANGO) :-

CHEMICALS :-

1. Potassium bi-tartarate
2. Calcium tartarate
3. Potassium tartarate
4. Calcium Chloride
5. Sulphuric acid

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6. Calcium Sulfate
7. Calcium carbonate
8. Calcium dichloride
9. Deninges Reagent
10. Potassium permagnate
11. Iron sulfate
12. H_2O_2
13. Sodium Hydroxide

APPARATUS:-

1. Conical Flask
2. Plastic bottle
3. Test tube
4. Burette stand
5. Funnels
6. Separating funnel
7. Knifes
8. Filter paper
9. Glasswares
10. Soxhlet Apparatus

EXTRACTION OF TARTARIC ACID FROM FRUITS[10] :-

- Fruits extracted using 1:2 volumes ratio of water: pulp at a temperature in the range of 25^0C to 100^0C on a hot plate at about 6hrs.
- Cool the extract for hrs at a temperature of 10^0C. then the Potassium Bi-tartarate is precipitated. The mother liquor is kept a side.
- The obtained potassium bi-tartarate is dissolved in sufficient amount of water, add carefully known grams of calcium carbonate in powder Bi-tartarate.It becomes calcium tartarate and neutral potassium tartarate this reaction releases CO2.
- Known grams of calcium chloride is dissolved into the hot water and added to the above. Here, a Double exchange reaction takes place.
- The obtained precipitates are filtered, to the obtained precipitate add 25ml of 96% H2SO4 and after 30min calcium tartarate are decomposed to pure tartaric acid and at the bottom calcium sulfate settles.
- Filter while it is still hot. Wash many times the sulfate that contains still quantities of tartaric acid and add the washing water to the filtrate.
- Let it evaporates for 6-10 days, than we will collect crystals of tartaric acid[8].

METHOD[11] :-

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- Take a 14.3 g of extract in 120 ml water under 100^0C. 5.7 g of $CaCo_3$ to release CO_2 by the tartarate of calcium then add 5.7 g of $CaCl_2$ solvent in potassium tartarate to change the calcium tartarate.Then filter the solution with 3% of sulphuric acid in 45 ml of water. After the filtration then boil 30 min in water bath .

GENERAL TEST[12] :-

1) Preparation of sample solution :-

Crystals of organic acids are dissolved in distilled water .

2) Neutralisation of sample :-

Neutralised by adding dil.NH_4OH solution by drop wise neutralization point is tested by litmus test (PH 7).

3) Calcium Chloride test :-

Few drop of 5% calcium chloride solution is added to small quantity of neutralised sample solution . No immediate white ppt., ppt. occurs slowly shaking the mixture in after 15 min.

CONFIRMATORY TEST :-

1) Deniges test :-

To a small quantity of neutralised sample solution .a few drops of deniges reagent is added .Then the mixture is heated After addition of a drop of 5% $KMNO_4$ solutions. After 10 min they show Permangate colour is discharged leaving a clear solution.

2) Fentons test :-

Few mg of tartaric acid add 1 ml of $FeSO_4$, trated with 1 ml of H_2O_2 in the addition of 1-2 ml of 10% NaOH for 10 min. Purple or brown ppt form.

RESULT :-

1) TAMARIND

❖ **General Test :-**

Sr . No	Test	Observation	Inference
1	Calcium Chloride test	No immediate white ppt., ppt. occurs slowly shaking the mixture .	Presence of tartaric acid.

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❖ **Confirmatory Test :-**

Sr . No	Test	Observation	Inference
1	Deniges test	Permangate colour is discharged leaving a clear solution.	Presence of tartaric acid.
2	Fentons test	Purple or brown ppt form.	Presence of tartaric acid.

- The % yield of Tamarind in 250 gm sample taken was found to be 6% .

2) GRAPES :-

❖ **General Test :-**

Sr . No	Test	Observation	Inference
1	Calcium Chloride test	No immediate white ppt., ppt. occurs slowly shaking the mixture.	Presence of tartaric acid.

❖ **Confirmatory Test** :-

Sr . No	Test	Observation	Inference
1	Deniges test	Permangate colour is discharged leaving a clear solution.	Presence of tartaric acid.
2	Fentons test	Purple or brown ppt form.	Presence of tartaric acid.

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- The % yield of grapes in 250 gm sample taken was found to be 4.3% .

3) MANGO :-

❖ **General Test :-**

Sr . No	Test	Observation	Inference
1	Calcium Chloride test	No immediate white ppt., ppt. occurs slowly shaking the mixture.	Presence of tartaric acid.

❖ **Confirmatory Test :-**

Sr . No	Test	Observation	Inference
1	Deniges test	Permangate colour is discharged leaving a clear solution.	Presence of tartaric acid.
2	Fentons test	Purple or brown ppt form.	Presence of tartaric acid.

- The % yield of mango in 250 gm sample taken was found to be 3.2% .

DISCUSSION :-

In the modified process developed, two commercially important constituents of the tamarind, grapes, mango are potassium Bitartrate and tartaric acid.

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It enables recovery of products of commercial value from tamarind, grapes, mango, a raw material abundantly and cheaply available in tropical countries and we use less expansive chemicals for the recovery. As a result, the process becomes economically more competitive compared to other process.

Tartaric acid and isopropyl alcohol each form an ester with Cr, resulting in a termolecular complex that greatly enhances the reduction over that which would occur with only tartaric acid. By reducing Cr will enhance the yield in agriculture.

CONCLUSION :-

The wide variety of uses for Tamarind ,grapes, mango in many of the countries has not been exploited, although in the future the area and extent of production are likely to increase as tamarind assumes greater recognition and importance.

In the research they show that the more amount of tartaric acid isolated in a tamarind than the two other mango and grapes fruits.

Tartaric is an unusual plant acid formed from the primary carbohydrate products of photosynthesis, and once formed, it is not metabolically used by the plant. The content of tartaric acid does not decrease during fruit ripening, suggesting it is not utilized in fruit development.

This research can implement further to get more amount of acid with this modified process in large scale instead of using expensive chemicals and rare equipments.

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