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Sudan University of Science & Technology

College of Agricultural Studies

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بحث تخرج لنيل درجة البكالوريوس بعنوان:

(The effect of backing in different containers on shelf life of guava Psidium guajava L. fruits)

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Abstract :

The experiment conducted in the period from 2019 to 2020 at horticultural lab – faculty of agricultural studies Sudan university of science and technology .

To studies the effect of differed container on weigh losses and damage on guava fruits .

The results confirmed that maximum weight loss after 24-48 and 72 hours registered in control (15 Kg capacity weight) and T5 (14-15kg capacity weight) compared with recorded in T2 and T3 followed by T4 and T1 . the highest fruit damage percent after 72 hours observed in container and T5 however the low lost fruit damage percent recorded in T4 , T3 , T1 and T2 subsequently hence T3 was the best treatment for minimum fruit weight loss and damage .

المستخلص :

اجريت التجربة في الفترة من 2019 الى 2020م بمختبر البساتين بكلية الدراسات الزراعية بهدف دراسة اثر الانواع المختلفة من العبوات على نسبة الفاقد في الوزن و نسبة التالف في ثمار الجوافة . بعد 24 ،48 – 73 ساعة

اثبتت النتائج ان اعلى فقد في الوزن كان في المعاملة المحايدة control و في المعاملة T5 (سعة العبوة 14–15 كيلو جرام) و اقل فقد في الوزن كان في المعاملة T2, T3 اللذان تساوا في فقد الوزن ثم تليها المعاملات T1, T4 على التوالي .

اعلى نسبة للثمار التالفة بعد 72 ساعة ثلاثة ايام من التخزين الثمار في العبوات المختلفة كانت في المعاملة المحايدة (control) و المعاملة T5 (سعة العبوة).

و اقل نسبة للثمار التالفة رصدت في المعاملة T4 , T 3 , T1 على التوالي – مما يؤكد ان المعاملة T3 كانت بها اقل نسبة فقد في الوزن و اقل نسبة في الثمار التالفة .

Introduction

The guava tree (Psidium Guajava L.) which belongs to the family Myrtaceae is considered as one of the most important tropical fruit trees in the world, enriching the diet of hundreds of millions of people with its special characteristic odor and high nutritive value (Morton, 1987; El- Bulk, 1997). In India, guava is known as ‘a poor man apple’ because of its high nutritional value and low price (Poovaiah, 1988). However, the tree is widely distributed in all warm areas of tropical America, Africa and Asia since 1526 (Morton, 1987; Krishna and Hari Babu, 2002) The place of origin of the guava is believed to be an area extending from the Southern part of Mexico up to the Centre a l part of America. It h a s been disseminated by m a n, birds and other animals to all warm areas of tropical America and the West Indies . The guava fruit is a berry with a large seedy core. The fruit may be smooth or ridge and waxy. Guava is a shallow rooted shrub with s p reading branches. The height i s general l y 4-5 meters but older trees m a y reach a height of 9 meters. In the indigenous areas of tropical America including Peru, Mexico and Cuba, it grows wild as bushes . Presently guava is being grown all over the sub-tropical and tropical world due to its high dietary value and good flavor. Guava fruit contains high amounts of Vitamins A, B1(Thiamin), B2 (Riboflavin) and C. It is a rich source of vitamin C (Ascorbic acid). The vitamin C contents of guava fruit are four times higher than those of citrus. The leaves of guava have been used for curing diarrhea and dysentery. Guava is commercially picked when it starts turning from green to yellow so that it rips one day later in the transit before marketing. Guava can be grown on a wide variety of soils from heavy clay to light sandy soil and with a range of pH 4.5 (acidic) to 8.5 (alkaline). It is tolerant to wet and saline conditions on good soil and with proper care the trees are highly productive.

Guava produces high yield of good quality fruit in climates where there is a distinct winter season. Several edible species of the genus Psidium like Psidium cattleianum (strawberry guava), P. guineense Sw (Brazillian guava), P.araca Raddi, P. friedrichs thaliannum (Ben.) Nied. (Cos ta Rican guava) and P. britoa acida Ben . (Para guava) are grown in various parts of the world (Ahmad, 1986).

Guava is a very productive and highly profitable fruit crop. It is liked by fruit growers due to its wide adaptability and higher return per unit area (Khan, 1985). But its successful cultivation is hampered by a number of biotic and abiotic factors. Among the biotic factors, diseases take a heavy toll. Some important guava diseases include guava decline, wilt, anthracnose, Botryodiplodia rot, fruit rot, Phomarot, Rhizopus rot, collar rot, Pestalotia leaf spot, Cercospora leaf spot, stem canker and seedling blight. (Muhammad Sarwar, 2006).

Continuous monitoring of larvae and adults insect pests population numbers are essential to assess the necessity and success of the any control programme. Guava is a climacteric fruit,. Out of many causes for decline in its yield, insect pests contribute to the maximum strength. There are many fruit insect pests in almost all guava fruit growing areas of the world and their economic importance can be summarized as; they attack commercially produced fruits, some species have become pests in regions far removed from their native range, in such cases quarantine restrictions have to be imposed to limit further spread of fruit pests. Quarantine regulations imposed by an importing country can either deny the produce of producing country, or force the producer to carry out expensive disinfestations treatment. Zinc deficiency is a significant abiotic problem.

Production of guava has to be increased to meet the demand of the domestic and overseas market. An increase in production needs to be followed by good post-harvest handling. As a horticultural produce, guava still live after its harvest. Guava has high respiration rate, and hence is easily damaged. Besides, guava is a climateric fruit, which reaches its respiratory and ethylene production peak during ripening. Harvest time and postharvest handling must be done properly to produce guavas with good quality. Postharvest handling of guava includes sorting, cleaning, grading, packaging, storage and transportation. Good handling practices will maintain quality and shelf life of guava. Guava is a climacteric fruits that had peak of respiration and ethylene production during ripening. Guavas is a fruit that easily damage. High respiration rate of guava make it easily damaged (Singh and Pal 2007).

Description:

It is a low evergreen tree or shrub 6 to 25 feet high, with wide-spreading branches and square, downy twigs, is a native of tropical America. It is a common vegetation cover by roads and in waste places in Hawaii. Guava is a tropical and semitropical plant. It is well known in the islands for its edible fruit. It is common in the backyards. The branches are crooked, bringing opposite leaves. The flowers are white, incurved petals, 2 or 3 in the leaf axils, they are fragrant, with four to six petals and yellow anthers. The fruit is small, 3 to 6 cm long, pear-shaped, reddish-yellow when ripe.

Chemical composition:

- ***The fruit:***

The fruits also contain vitamin C [Hernandez] vitamin A, iron, calcium and phosphorus [Iwu, Burkill]. Guavas are up to 5 times richer in vitamin C than oranges [Conway]. Manganese is also present in the plant in combination with phosphoric, oxalic and malic acids [Nadkarni & Nadkarni]. The fruit contains saponin combined with oleanolic acid. Morin-3-O-α-L-lyxopyranoside and morin-3-O-α-L-arabopyranoside and flavonoids, guaijavarin (Fig.1) and quercetin (Fig.2) [Arima and Danno]. The essential oil and headspace of fresh white-flesh guava fruits. In the headspace, the major constituents were: hexanal (65.9%), γ-

butyrolactone (7.6%), (E)-2-hexenal (7.4%), (E,E)-2,4hexadienal (2.2%), (Z)-3-hexenal (2%), (Z)-2-hexenal (1%), (Z)-3-hexenyl acetate (1.3%) and phenol (1.6%), while β-caryophyllene (24.1%), nerolidol (17.3%), 3-phenylpropyl acetate (5.3%) and caryophyllene oxide (5.1%) were.

The major volatile constituents present in the hydrodistilled essential oil [Paniandy et al]. The occurrence of pentane-2-thiol was found in the fruits [Bassols and Demole].

In the pink fruit, the commercial essence was characterized to present a volatile profile rich in components with low molecular weight, especially alcohols, esters, and aldehydes, whereas in the fresh fruit puree terpenic hydrocarbons and 3-hydroxy-2-butanone were the most abundant components. New components were described for the first time as active aromatic constituents in pink guava fruit (3-penten-2-ol and 2- butenyl acetate). Principal differences between the aroma of the commercial guava essence and the fresh fruit puree could be related to acetic acid, 3-hydroxy-2-butanone, 3-methyl-1-butanol, 2,3-butanediol, 3-methylbutanoic acid, (Z)-3-hexen-1-ol, 6- methyl-5-hepten-2-one, limonene, octanol, ethyl octanoate, 3-phenylpropanol, cinnamyl alcohol, α-copaene, and an unknown component. (E)-2-Hexenal seems to be more significant to the aroma of the commercial essence than of the fresh fruit puree.

- ***The fruit skin***

Ascorbic acid–mainly in the skin, secondly in the firm flesh, and little in the central pulp–varies from 56 to 600 mg. and may range to 350-450 mg in nearly ripe fruit. It can decline to 50-100 mg. Canning or other heat processing destroys about 50% of the ascorbic acid. The strong odour of the fruit is attributed to carbonyl compounds.

- ***The leaves***

The leaves contain essential oil with the main components being α-pinene, β-pinene, limonene, menthol, terpenyl acetate, isopropyl alcohol, longicyclene, caryophyllene, β-bisabolene, caryophyllene oxide, β-copanene, farnesene, humulene, selinene, cardinene and curcumene [Zakaria]. The essential oil from the leaves has been shown to contain, nerolidiol, β-sitosterol, ursolic, crategolic, and guayavolic acids have also been identified [Iwu]. The leaves contain fixed oil 6%, and volatile oil 0.365% [Burkill] 3.15% resin, 8.5% tannin, and a number of other fixed substances. The essential oil contains eugenol [confirmed Nadkarni & Guajavolide (2 α-,3 β-,6 β-,23-tetrahydroxyurs-12-en-28,20 β-olide; 1) and guavenoic acid (2 α-,3 β-,6 β-,23-tetrahydroxyurs-12,20(30)-dien-28-oic acid; 2) along with one known triterpene oleanolic acid (3) were isolated from the fresh leaves of Psidium guajava [Begum et al].

- ***The bark***

The bark contains 12-30% of tannin and one source says it contains tannin 27.4%, or polyphenols [Burkill], resin and crystals of calcium oxalate [Nadkarni and Nadkarni].

- ***The roots***

The roots are also rich in tannin [Quisumbing].The plant also contains leukocyanidins, sterols, and gallic acid in the roots [Iwu]. There is a high percentage of carbohydrates and salts. Root, stem-bark and leaves contain a large percentage of tannic acid.

- ***The seeds***

The seeds which are very small but abundant in the fruit and have been reported to contain 14% oil on dry weight, with 15% proteins and 13% starch [Burkill]. Ten phenolic and flavonoid compounds including one new acylated flavonol glycoside were isolated. The structures of the new compound quercetin-3-O-β-D-(2''-O-galloyl glucoside)-4'-O-vinylpropionate and of the known compounds were elucidated [Michael et al].

- ***The plant in general***

Also present amritoside [Conway] which is a glycoside (gentiobioside) of ellagic acid. Another biologically interesting compound in the plant is guiajaverin, a glycoside

(arabinopyroside) of quercetin. The leaves also contain essential oils and triterpenoids [Wyk et al].

- ***The twigs***

Twigs contain calcium (0.30-1.00%), magnesium (0.06-0.30%), phosphorous (0.10-0.38%), potassium (0.21-0.39%), and sodium (0.03-0.20%). The concentration of fluoride ranged from 0.02 to 0.11 ppm, copper (0.02-0.14 ppm), iron (2.86-5.14 ppm), zinc (0.31-0.57 ppm), manganese (0.00-0.26 ppm), and lead (0.00-0.11 ppm) [Okwu and Ekeke].

- ***Medicinal use:***

(Various): Stem, bark and root-bark are astringent. Unripe fruit is indigestible, causes vomiting and feverishness. Bark is astringent, febrifuge, antiseptic. Fruit is laxative,leaves are astringent [Nadkarni and Nadkarni]. Locally,decoction of the leaves is applied with much benefit to the prolapsus ani of children; [Nadkarni and Nadkarni].Indians also employ it for sore throats, vomiting, stomach upsets and for vertigo [Raintree].

Antibacterial activity: The extract also showed in vitro antimicrobial activity against Escherichia coli, Salmonella typhi, Staphylococcus aureus, Proteus mirabilis, and Shigella dysenteria [Iwu]. Another paper showed the effectiveness of the leaf extract against Staphylococcus aureus [Gnan and Demello]. It was shown to antibacterial in another study and in addition to

Staphylococcus aureus was also useful against Streptococcus spp [Pranee]. The leaves are rich in tannin, and have antiseptic properties [Hernandez].

A strong antimicrobial action of guava leaves on Gram-positive and Gram-negative organisms has been reported (Sarcina lutea and Staphylococcus aureus) and also noted action on Mycobacterium phlei. The flavone derivatives isolated were reported to inhibit the growth of Staph. aureus in a dilution of 1:10,000 [Oliver-Bever].

The bark was also shown to exhibit antibacterial effects [Ali et al], it might well be that this activity could be attributed to the tannins present [Lutete et al]. The effectiveness of Guava as an antimicrobial was confirmed by [Abdelrahim et al] Four antibacterial compounds were isolated from leaves of guava (P. guajava), two new flavonoid glycosides, morin-3-O-α-L-lyxopyranoside and morin-3-O-alpha-L- arabopyranoside, and two known flavonoids, guaijavarin and quercetin [Arima and Danno].

Psidium guajava leaf and bark tincture was subjected to in vitro sensitivity tests by serial dilution at concentration ranging from 5% to 15% against six test dermatophytes viz. Trichophyton tonsurans, T. rubrum, Trichosporon beigelii, Microsporum fulvum, M. gypseum and Candida albicans. Bark tincture exhibited higher efficacy in controlling the mycelial

growth of dermatophytes than the leaf tincture. The tincture showed fungicidal property in different concentrations but exhibited only fungistatic property in case of C. albicans. [Dutta et al]. Another paper showed good effect with the methanolic extract [Rabe and Staden].

A leaf extract enters into a Nigerian remedy for skin infections, and examination has shown a positive action on Gram-positive microbial organisms, but no action on Gram-negative organisms, nor any antifungal action. Three antibacterial substances have been detected in the leaves which are derivatives of quercetine. As in the bark polyphenols and many other substances are present [Burkill].

- ***Anti-diarrhoeal***

A leaf infusion is taken in Ghana and Nigeria for stomach complaints e.g. constipation, and in Adamawa with “red” potash for dysentery; a decoction is taken in Senegal to combat diarrhoea and dysentery; the shoots and roots may also be used, while in neighbouring The Gambia the leaves are chewed for queezy tummy, a treatment that is said to work very well. A leaf infusion is drunk in Hawaii and Trinidad, and in Indonesia for medical purposes. [Burkill]. The ripe fruit is mildly laxative. The unripe fruit is astringent, anti-diarrhoeic, and has medicinal use [Burkill]. The ripe fruit is a good aperient, and should be eaten with the skin,

for without it, costiveness results. The unripe fruit is said to indigestible, causing vomiting and feverishness, but it is sometimes employed for diarrhoea. [Conway].

In Peruvian herbal medicine systems today the plant is employed for diarrhoea, gastroenteritis, intestinal worms, gastric disorders and vomiting [Raintree].

The leaves of the guava tree in decoction are recommended for gastrointeritis, chronic diarrhoea, etc., the young leaves and shoots are used for dysentery and diarrhoea. [Ticzon].

The Tikuna Indians of South America decoct the leaves or bark of guava as a cure for diarrhoea. An infusion or decoction made from the leaves and/or bark has been used by many tribes for diarrhoea and dysentery throughout the Amazon [Raintree]

The roots are astringent and in India and Ghana are used for childhood diarrhoea (root bark); diarrhoea (roots with water); dysentery (roots with water) [Ayensu]. The bark and leaves are astringent, vulnerary, and when decocted can be used for diarrhoea.A tisane of the bark (and of the leaves) is taken in Congo against diarrhoea [Burkill].Internally the bark is used in the chronic diarrhoea of children and sometimes adults. The root bark has been recommended for chronic diarrhoea. In a decoction of half ounce in 6oz water, boiled down to 3 oz and given in teaspoonful doses; and also recommended as a local

application in prolapsus and of children. Guava leaves are commonly used in South Africa as a remedy for diarrhoea [Wyk et al].Modern proof of the traditional use can be found in modern studies. The methanolic extract of P. guajava (leaves) showed significant inhibitory activities against the growths of 2 isolates of Salmonella, Shigella spp. (Shigella flexneri, Shigella virchow and Shigella dysenteriae) and 2 isolates of the enteropathogenic Escherichia coli. The results have confirmed the effectiveness of this Zulu medicinal plant as an antidiarrhoeal agent. [Lin et al]. Guava sprout extracts (P. guajava) by 50% diluted ethanol showed the most effective inhibition of E. coli, while those in 50% acetone were less effective. It is concluded that guava sprout extracts constitute a feasible treatment option for diarrhoea caused by E. coli or by S. aureus-produced toxins, due to their quick therapeutic action, easy availability in tropical countries and low cost. [Vieira et al]. A further paper proving the anti-diarrhoeal activity has been seen [Lutterodt] and since the extract was effective against Staphylococcus aureus (present in wounds) would also be an excellent treatment for infections. In a further paper the author suggested that the effect of guava might be caused by the inhibition of the increased watery secretions that occur commonly in all acute diarrhoeal diseases and cholera [Lutterodt; 1992]. The guava always seems to come out well in screening studies to further confirm its value in this area. [Tona

et al; Lozoya et al]. It has been proposed that the quercetin present can inhibit the intestinal movement and reduce capillary permeability in the abdominal cavity and this may explain the antidiarrhoeal mechanism of Psidium guajava extract [Zhang et al].In India and Ghana the green fruit and leaf decoction is considered astringent and used for diarrhoea and dysentery. The ripe fruit is considered laxative in India [Ayensu]. In Costa Rica, a decoction of the flower buds is considered an effective remedy for diarrhoea. [Ayensu]. In child cases, the treatment with guava has good curative effect on infantile rotaviral enteritis [Wei et al]. A weak infusion of the leaves and tender branches is dispensed for diarrhoea. In Malayan traditional medicine it is used to cure stomach ache and the remedy is to drink water boiled with the leaves and shoots. It also helps to stop purging or griping often associated with this condition [Zakaria].

Anti-inflammatory effect: The anti- inflammatory and analgesic activities of 70% ethanolic extract of Psidium guajava was investigated in rats using the carrageenin- induced hind paw oedema model. Extracts which exhibited antiinflammatory activity were screened for analgesic activity using the Randall-Selitto method in rats. The extracts were administered at a dose of 300 mg/kg, p.o. Aspirin (300 mg/kg, p.o.) was employed as the reference drug. Psidium guajava leaves, showed significant anti- inflammatory activity with percentage inhibitions of

58.27%. [Muruganandan et al].

The essential oil has also been proven to have anti-inflammatory effect. The essential oil, steam-distilled from leaves of P. guajava leaves, was given orally rats to study its effects on the exudative and proliferative phases of the inflammatory reaction (carrageenan-induced paw oedema and cotton pellet-induced granuloma models). The essential oil (0.8 mg/kg) significantly reduced oedema formation induced by carrageenan. The essential oil (0.4 and 0.8 mg/kg) significantly reduced granuloma formation induced by cotton pellets. [Kavimani et al]. Another paper confirmed the anti-inflammatory activity and also showed significant antipyretic activity and potent anti-arthritic activity in rats [Sen et al]. In Peru it is said to be good for oedema [Raintree].Another modern study confirms many of the traditional uses. The methanol extract of guava leaves was found to inhibit paw oedema induced by carrageenan in rats, and pain induced by acetic acid in mice, and it exhibited an antipyretic effect in mice. The oral administration of the extract reduced intestinal transit time and prevented castor oil-induced diarrhoea in mice [Olajide et al].

Antispasmodic: This plant is among the aromatic antispasmodics; a decoction of the young leaves and shoots is prescribed in the West Indies for febrifuge and antispasmodic baths. In India and Ghana the stem and twigs are considered

astringent (bark as well). In the West Indies it is used as a febrifuge, antispasmodic bath (decoction of shoots and young leaves) [Ayensu]. They are recommended for swollen legs. The young leaves and shoots are used for The leaves of the guava tree in decoction It has been used for spasms, fevers, worms, diabetes [Ticzon].

CNS activity: The leaves of the guava tree in decoction is used for spasms, epilepsy and even for cerebral affections [Ticzon]. The cerebral aspects of the plant may be seen in the CNS depressant activity due to the presence of caryophyllene-oxide and β- selinene that has been seen for the plant [Meckes et al] extracts exhibited mostly dose-dependent antinociceptive effects in chemical and thermal tests of analgesia. The extracts also produced dose-dependent prolongation of pentobarbitone-induced sleeping time [Shaheen et al]. In India the leaf infusion is used for cerebral infections [Ayensu]. The tincture has been employed by rubbing it into the spine of children suffering from convulsions. It has also been used as a tonic in psychiatry [Zakaria]. A CNS-depressant activity was exhibited by the extract which potentiated the phenobarbitone sleeping time in mice. [Olajide et al]. An extract is used for epilepsy and chorea (any of several degenerative nervous disorders characterized by spasmodic movements of the body and limbs) [Quisumbing].

Conjunctivitis: Flowers are also used as a poultice for

conjunctivitis [Ayensu]. This use is reflected by that in the Amazon, where the flowers are also mashed and applied to painful eye conditions such as sun strain, conjunctivitis or eye injuries [Raintree].

Coughs: Boiled with lemon grass (Cymbopogon citratus) to make a decoction that is is drunk for coughs. A decoction is also taken in Senegal for tracheobronchitis [Burkill]. The leaves are also used for cough [Wyk et al] a use also followed in Peru [Raintree].

Diabetes: The leaves are also used for several other ailments including diabetes. The leaf infusions are used in the Cape for diabetes [Wyk et al]. Water in which the fruit is soaked is good for thirst in diabetes [Conway].

Food uses: The fruit is sweet and is eaten raw or cooked. It makes good jam and is universally known for its jelly [Burkill]. The fruit is rich in vitamin C, and is eaten raw, candied, or made into jellies and jams [Hernandez]. The fruits are edible and the juice is used as a refreshing drink [Iwu]. Eating the fruit may well have longer term cardioprotective effects as a result of the antioxidant and free radical protection the plant was proved to offer [Yamashiro et al]. The fruit is also a source of antioxidant dietary fibre [Jimenez-Escrig et al]. Guava powder containing 2,500-3,000 mg ascorbic acid was commonly added to military rations in World War II.

Gout: Fruits are recommended for gout. [Conway].

Haemostatic: Said to stem the flow of blood. [Ayensu]

Kidney problems: The young leaves and shoots are used for inflammation of the kidney and kidney problems [Ticzon]. In India the leaf decoction used for nephritis (an inflammation of the kidney) [Ayensu].

Malaria: The leaves are used as an ingredient in the preparation of fever "teas". They are also used as part of the pot herb used in steam treatment for malaria. Indeed, the main ethnotherapeutic use in Africa is said to be for malaria. Psidium guajava stem-bark extract contained anthraquinones, flavonoids, seccoirridoids and terpenoids and was found to be effective for the treatment and/or prophylaxis of malaria in KwaZulu- Natal province of South Africa. The in vitro antiplasmodial assay was carried out using a chloroquine-sensitive strain of malarial parasite [Nundkumar et al]

Oral Care: In the lagoon area of coastal Ivory Coast young twigs serve as chew- sticks [Burkill]. In southern Nigeria the twigs are used as chew sticks and the presence of bioactive compounds comprised of saponins, tannins, flavonoids, and alkaloids is responsible for their effectiveness. Chewing sticks when used without toothpaste are very efficient, effective, and

reliable for cleaning teeth. The teeth of
chewing sticks users are usually strong, clean, fresh, and devoid of dental plaques and carries [Okwu and Ekeke].

In South America: The tender leaves are chewed for bleeding gums and bad breath, and it is said to prevent hangovers (if chewed before drinking). Indians throughout the Amazon gargle a leaf decoction for mouth sores, bleeding gums. In Brazil guava is considered an astringent and diuretic and is used for the same conditions as in Peru. A decoction is also recommended as a gargle for sore throats, laryngitis and swelling of the mouth [Raintree Tropical Data Base].

Chewing sticks when used without toothpaste are very efficient, effective, and reliable in cleaning the teeth of many people in Southern Nigeria. The teeth of the users of chewing sticks are usually strong, clean, fresh, and devoid of dental plaques and carries. These results indicate the basis for the preventive and protection of the teeth against caries and plaques by the samples used.

In Ghana and in Nigeria the leaves are chewed to relieve toothache. [Burkill]. A decoction of the root-bark is recommended as a mouthwash for swollen gums and a decoction of the leaves makes an efficacious gargle for swollen gum and ulceration of the mouth [Nadkarni and Nadkarni] and also for

bleeding gums [Conway].It is used in the Amazon to regulate menstrual periods. or use it as a douche for vaginal discharge and to tighten and tone vaginal walls after childbirth. [Raintree].

Parturient: A combined decoction of leaves and bark is given to expel the placenta after childbirth.

Pharmacological effects and studies: The aqueous alcohol extract has been shown to exhibit sedative activity [Iwu].Ellagic acid is a known intestinal astringent and haemostatic which explains the therapeutic value of the plant against diarrhoea and dysentery. The tannins are generally of value because of their vasoconstricting effects and their ability to form a protective layer on the skin and various mucosa. These effects, together with proven antibacterial and antifungal activity, result in effective treatment of both internal and external infections. Quercetin (and its glycosides) undoubtedly also contribute to the efficacy of the medicine, because it is a known antioxidant with anticarcinogenic, anti-HIV and antibiotic effects. ypoglycaemic effects have been documented [Wyk et al].

Rheumatism: Pulped leaves are made up into a suppository in Congo for treating piles [Burkill]. The pounded leaves in India are used for rheumatism [Ayensu; Quisumbing].

Skin use: The benefits are many and the plant can provide astringency, wound healing and skin damage repair properties

that follow from the ethnopharmaceutical traditions of the plant. The antimicrobial properties of the plant may also be of benefit in certain product applications.In Mexico the leaves are said to be a remedy for itches. The leaves of the guava tree in decoction is used as a wash for ulcers and especially where an astringent remedy is needed [Ticzon].In the Amazon, a decoction of the bark and/or leaves or a flower infusion is used topically for wounds, ulcers and skin sores [Raintree].In addition the antioxidant activity will provide a caring environment for the skin. A method of detection for guava is described in the literature [Masuda et al]The use of the flowers may be applicable in eye products for their soothing effect.

A solvent extraction of the Psidium guajava leaves had an antiallergic activity. The study was performed in single-blind challenge test of Psidium guajava cream in 46 atopic dermatitis patients. Improvement of clinical symptoms (activity of eczema, pruritus, sleep disturbance, etc) and various inflammatory markers were evaluated to examine the effect of the 0.45% Psidium cream after 4-8 weeks. The result revealed that acute clinical symptoms were improved. Psidium cream may be a valuable adjunctive therapy in the management of atopic dermatitis [Suzuki et al].In the Philippines the astringent, unripe fruit, the leaves, the cortex of the bark and roots – though more often the leaves only – in the form of a decoction, are used for

washing ulcers and wounds [Quisumbing].

The leaves of the guava tree in decoction are traditionally used to heal wounds and cuts. [Ticzon]. The leaves are also used ulcers, boils, and wounds [Wyk et al].

In India it is considered astringent wounds and ulcers [Ayensu]. Locally, decoction of the leaves is employed in scurvy and for unhealthy ulcers [Nadkarni and Nadkarni]. The decocted leaves are used in Mexico for cleansing ulcers. The ground leaves make an excellent poultice [Nadkarni and Nadkarni]. Ground up with kaolin and water to a paste, they are applied in Ghana to the body as an ointment for measles [Burkill].

In Brazil guava is used in decoction externally for skin ulcers [Raintree]

Tonic: It is used as a restorative aid in convalescence [Conway]. It is also for cachexia (any general reduction in vitality and strength of body and mind resulting from a debilitating chronic disease) [Ayensu]. The astringency of these preparations may be masked by the addition of lime juice. From leaf buds, the Hawaiians make a medicinal tea, which has an astringent effect. Guava jelly is tonic to the heart and good for constipation [Nadkarni and Nadkarni].

Vaginal disorders: In Uruguay, a decoction of the leaves is used as a vaginal and uterine wash, especially in leucorrhoea

where it can be infused and applied as a douche [Conway]. The leaves of the guava tree in decoction are recommended for uterine haemorrhage. The same decoction is used as a wash for vaginal and uterine problems, and especially where an astringent remedy is needed [Ticzon]. Water in which the leaves have been boiled is taken in Senegal to assist menstruation [Burkill]. In Peruvian medicine the leaves are used for vaginal discharges, menstrual pain and haemorrhages [Raintree]. In Brazil guava is considered an astringent and diuretic and is used for the same conditions as in Peru. A decoction is used externally for vaginal irritation and discharges." [Raintree]

Other uses: A black dye is made from it in E. Africa for dyeing matting, silk and cotton. It is used in Gabon for tanning hides [Burkill].

Parts used: The whole plant, although in some areas only the leaves and stems are used [Zakaria].

Dose: 30 to 60 grams for 1 litre of water. 4 to 5 cups a day For diarrhoea: half an ounce of the bark is boiled down with six ounces of water to 3 ounces; the dose (for children) is one teaspoonful 3 or 4 times a day.

Root-bark is successfully employed in chronic infantile diarrhoea in the form of a concentrated decoction (1 in 12), or 2

oz of the bark in a pint of water boiled down to half a pint. Dose is 1 drachm or 1-2 teaspoons two or three times daily [Nadkarni and Nadkarni].

Crushed leaves are boiled in water and the infusion is either taken orally as a tea or as an enema. For severe diarrhoea, an infusion of one crushed leaf in a litre of water is used [Wyk et al].

The root-bark has been recommended in chronic infantile diarrhoea, in decoction of
1/2 oz. in 6 oz of water, boiled down to 3 oz., and given in teaspoonful doses [Dey].

Safety data: A case report of a 17-year-old student who developed contact dermatitis to Psidium guajava is presented. He was treating his eczema by bathing in water (50 litres) infused with a 30 g guava tea bag. Patch testing revealed allergies to various constituents of guava leaves.

The LD50 of the aqueous extract was >5 g/kg, p.o. [Pranee].

The effect of Psidium guajava leaf extract (collected from Thailand) on the bleeding time and the 3 main mechanisms of haemostasis: vasoconstriction, platelet aggregation and blood coagulation, were investigated. The water extract did not shorten bleeding times in rats. The extract did not affect bleeding times,

it stimulated vasoconstriction and platelet aggregation but it inhibited blood coagulation. The leaf extract is not recommended as a haemostatic agent. [Jaiarj et al].

- ***Insect Pests on Guava Tree:***

Identification of adult and immature specimens was done by going through keys available in the literature. For mites' collection, suspected leaves were taped over white paper to see them and then stored in vials. Some other devices useful in certain situations for collecting some other types of insects were aspirator, sifter, traps and hand nets or directly by hand picking. The insect's counting data was subjected to statistical analysis using Duncan's Multiple Range Test.colour with a black head. They become pink as they approached maturity and attained a ength of nearly ¼ inch. The larvae of the fruit moth caused the damage to guava by tunneling through the fruit. Guava Whitefly (Metaleurodicus cardini) adults were greenish yellow with a fine dusting of white wax, wings dusky with a conspicuous dark spot near the center of each wing. As females deposited eggs, a fine trail of fluffy white wax was rubbed from a tuft of wax on the ventral side of the abdomen. The scale species (Coccus viridis) were damaging not only because they fed on sap, but also because of the toxicity of their saliva. Scales were found on the upper or lower surfaces of leaves and also on fruits. Scale insects were also

intermittently infesting guava plantings. The fruit tree was a problem at the peduncle junction, these weakened guava plants by puncturing the tissues and consuming sap, but the major damage was caused by the production of large amounts of honeydew upon which saprophytic fungi developed. The resultant thick black layer of sooty mould caused a drastic reduction in photosynthetic efficiency, resulting in premature leaf drop. False spider mite (Brevipalpus phoenicis) and stinkbugs were noted to damage the peel. The mite, as a tiny member of the arachnid family, damaged plants during hot and dry conditions, identified by leaf veins turning yellow or red-brown, then fine dusty looking webbing could be seen between leaves. Mite sucked the chlorophyll out of plant tissue leaving dried out leaves with yellow or red spots and blotches sometimes with tiny white dots. Stink Bug (Acrostemum hilare) generally green to brown, oval to elliptical, recognized most readily by the large triangular scutellum (plate that fits behind pronotum and between the forewings), because of their feeding behavior, left the superficial scars in fruits. Mealy bugs Pseudococcus sp. fed on leaves and fruits, weakened plants by puncturing the tissues and consuming sap, production of large amounts of honeydew upon which sooty mould developed, resulting reduction in photosynthetic efficiency and in premature leaf drop.

Oriental Fruit Fly, Bactrocera dorsalis was statistically the most important and destructive pest problem associated with guava in that area. The adult was noticeably larger than a housefly, but there was prominent yellow and dark brown to black colour with a black head. They become pink as they approached maturity and attained a length of nearly ¼ inch. The larvae of the fruit moth caused the damage to guava by tunneling through the fruit. Guava Whitefly (Metaleurodicus cardini) adults were greenish yellow with a fine dusting of white wax, wings dusky with a conspicuous dark spot near the center of each wing. As females deposited eggs, a fine trail of fluffy white wax was rubbed from a tuft of wax on the ventral side of the abdomen. The scale species (Coccus viridis) were damaging not only because they fed on sap, but also because of the toxicity of their saliva. Scales were found on the upper or lower surfaces of leaves and also on fruits. Scale insects were also intermittently infesting guava plantings. The fruit tree was a problem at the peduncle junction, these weakened guava plants by puncturing the tissues and consuming sap, but the major damage was caused by the production of large amounts of honeydew upon which saprophytic fungi developed. The resultant thick black layer of sooty mould caused a drastic reduction in photosynthetic efficiency, resulting in premature leaf drop. False spider mite (Brevipalpus phoenicis) and

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Postharvest Handling Practices in Maintaining Quality and Shelf Life of Guava:

The determination of appropriate harvest time is needed to

get guava with good quality. Maturity indices to determine the harvest time of guava be required to get guava that meet the quality parameters as well as the marketing period. Changes in colour, texture and the ratio of sugar and acid are determinants of guava maturity index (Kader 2009; Cavalini et al., 2006).

After its harvest, guava needs proper post-harvest handling to maintain its quality, increase shelf life and reduce losses. Damage in guava can be caused by rough handling, which resulted in bruises and wounds that makes it susceptible to microbial spoilage. Good handling practices need to maintain quality of guava. This paper will discuss aspects of the potentials of guava in Indonesia, harvest and post-harvest handling practices of guava.

- ***Harvest***:

Maturity stage of guava at harvest is an important factor in determining shelf life and quality. Unripe fruits are still susceptible to wrinkles and mechanical damage, and have a low quality flavor when ripe. Ripe fruits are easily soften and have bland flavor after harvest. Fruits that are harvested too quickly, more susceptible to physiological disorders than fruits that harvested at the appropriate maturity level (Kader and Rolle, 2004).

Unripe fruits, are usually hard in texture, starchy and acidic in taste and sometimes astringent. After ripening, they become soft,

sweet, non-acidic, less astringent and highly flavoured and hence are more acceptable as human food. In general, fruits will have the optimum eating quality when ripe on the tree. Several types of fruit can be harvested if its mature but not yet ripe so it can be held for long-distance transportation. Maturity index is a compromise between the indication of the condition of the fruit which ensures the best eating quality for consumers and provides flexibility in marketing (Kader and Rolle, 2004; Bashir and Abu Goukh, 2003).

Harvest time is an important factor associated with post-harvest loss of fruits and vegetables. For guava, harvest time is based on subjective evaluations such as fruit size, colour and texture, which may vary for each location depending on the type, time, age of the plant and orchad management. Generally, the fruit is harvested when the fruit begins to change colour from dark green to light green or slightly yellow.

The determination of appropriate harvest time, is needed to detect the precise stage of fruit ripening by maturity index. The index includes measures of physical and mechanical changes during fruit ripening. The indexes enables the production of fruit in good quality in terms of sensory characteristics, and ensure the proper treatment for storage (Cavalini et al., 2006).

Guava are picked at mature green fruit stage (colour changed

from dark green to light green) in countries where consumers prefer guava with the level of maturity like this. In countries where consumers prefer ripe guava, fruit picked when the fruit is yellow-texture but still hard or ripe half (softer) for long distance transportation. For local market guava are picked at full ripe level (yellow and soft) (Kader 2009).

From Table 3 it can be seen that the parameters of colour, texture and the ratio of sugar and acid can be used to determine the maturity index of guava. Color is a good indicator to determine the level of maturity; size and shape that may be also important for some markets.

The best way to harvest guava is by picking it with the stems. Harvesting is done after fruit is 4 months old. Harvesting should be done carefully, because guava is sensitive to physical damage. Guavas are then put in fruit baskets carried by pickers. After harvested, place the guava in the shade, because guava can be damaged if exposed to direct sunlight, while also avoiding the increase of fruit temperature (Warintek 2000; Kader 2009).

- ***Sorting:***

Bruised, wounded and rotten guavas are separated from healthy fruits. Sorting should be done immediately after the products came to packing house because it will determine the next process. Sorting is usually done before cooling or subsequent handling. Sorting will save energy because defect

products will not be treated. Treatment as soon as possible in the sorting can limit the damage, loss of crops, prevent microbial infection and other foreign materials. Separates of spoilage product will prevent the spread of infection to other products, especially if postharvest pesticides are not used (Utama, 2001; Setyabudi, 2010).

According to Indonesian National Standard, SNI 7418:2009, the minimum requirement that must be met for all classes of guava, are: whole, fresh appearance, compact, consumable, clean, free from foreign materials, free from bruises that cause changes in taste and appearance, free of pests and diseases, free of abnormal external moisture, condensation except immediately after removal from cold storage areas, free from foreign flavor and aroma, and free of bruises.

- ***Washing:***

Good/healthy guavas are then washed to remove the dirt. Washing can also reduce

microbes and reduce initial temperature of the product or removes field heat (precooling). Washing can be done in the bath or flowing water and then drained or air dried before the next treatment (Yulianingsih et al., 2009).

Washing process effectively removes impurities. Additional disinfectants material to washing water can control spoilage

bacteria and fungi. Chlorine is a common chemical that is added to control microorganism. However, chlorine is effective when the solution is kept at neutral pH. Treatment with concentrations of 100-150 ppm chlorine can help control pathogens for further operation (Utama, 2001).

Some treatments can be done to reduce or eliminate the microbes that damage to the guava. Omayima et al. (2010) conducted a research on the use of several treatments to reduce or eliminate microbes on guava. Mature yellowish-green guava cv. Maamouraj were treated with hot water, hydrogen peroxide (H2O2), calcium chloride, lemon grass oil fumigation and various combination between them and then stored at 8 ± 1°C with 90% relative humidity (RH) for 15 days. Fruits were transferred to room conditions at (22 ± 2°C and 55-60% RH) till the end of the marketable period. Effects of the treatment on postharvest rots of guava (cv.Maamouraj) presented at Table 4.

Fruits treated with calcium chloride + lemon grass fumigation were completely Rhizopus rot-free through 15 days storage at 8 ± 1°C. The sensory evaluation showed that this treatment could maintain appearance considered the most benefit fruit appearance, physical, chemical fruit properties and free from rots at 8±1°C for two weeks (Omayima et al., 2010).

- ***Grading:***

Grading is grouping guava based on a quality criteria. Purpose of grading is sorting the fruit based on grade/class criteria, color, weight, shape, and size. Grading can be done manually or by using machinery. Grading manually requires a trained operator. Operators must be trained in selecting the desired size. Measurements can be done subjectively (visually) by using the existing standard measuring instrument (Utama 2001; Kitinoja & Kader 2003).

Based on Indonesian National Standard, SNI 7418:2009 guavas are classified into three (3) classes, namely: super class, class A and class B (Table 4) and nine codes of guava size (Table 5).

- ***Packaging:***

Guava packaging consists of two types, namely primary packaging and secondary packaging. Primary packaging is packaging that is in direct contact with guavas. Secondary packaging is packaging a second tier that provides more protection to the packaged product.

One type of primary packaging is edible coating. Some studies use natural materials as edible coatings to maintain the quality of guavas. The application of chitosan coating, especially 2.0% (w/v) chitosan solution combined with a low temperature (11°C) delayed fruit ripening and maintained the quality of the fruit. The results suggested that chitosan showed positive effects

in maintaining membrane integrity and thus in delaying ripening process in guava fruit mainly through decrease the oxidative stress (Hong et al., 2012). The use of 2.5% chitosan as coating material on ripe guava 'Crystal' could significantly extend its shelflife, which is 2.83 and 6.12 days longer than dipping in water and 0.5% acetic acid at a room temperature (Soesiladi et al., 2013). The recent study show that dipping in Candeuba® wax as a SLN (Solid Lipid Nanoparticles) as edible coating of guava maintained the quality of guavas. The best results were obtained with SLN concentrations of 60 and 65 g/L since at these concentrations, guavas showed the lowest range of weight loss and preserved the best quality compared to the fruits processed at concentrations above 70 g/L (Zambrano-Zaragoza et al., 2013).

Secondary packaging must protect the product from damage due to environmental effects. Packaging that should meet at least three basic objectives, that are:

1. As product container, facilitate product handling and marketing with a standard amount per unit or weight in packaging.
2. Protect the product from injury (impact, pressure, abrasion and lesion) and protect from environmental stresses such as temperature and humidity during transportation, storage and marketing.

3. Provide information on the variety, weight, quantity per unit, quality grade, manufacturer name, country or region of origin that can be informed to consumers. (Pallipane and Rolle 2008).

Guavas should be packed in order to protect the fruit properly. The materials used for packaging must be clean and be able to prevent damage of external and internal fruit. The use of materials, especially paper or printed label of fruit spesifications is still possible with nontoxic ink or glue. Guava packed in containers in accordance with international recommendations for the packaging and transport of fresh fruit and vegetables (SNI7418:2009).

Packaging must meet the requirements of quality, hygiene, ventilation, and durability to ensure suitability for handling and delivery to maintain quality. Packaging should be free from foreign materials and aromas (SNI 7418:2009).

Fruits often have to be transported long distances after the harvest to reach the market. The use of woven polypropylene bags and crocus for transporting fruit, often causing losses due to the serious quantitative and qualitative physical or mechanical damages such as bruises and wounds that continues with decay of products. Postharvest losses can be minimized with the use of plastic crates for handling and transporting the fruit.

Stackable and nestable plastic box are suitable to transport fruits. Nestable box can be stacked and placed on top of each other, thus reducing storage space requirements for the transport of empty crates. The bottom and sides of the container must be perforated to allow adequate ventilation. Uniformity in size is very important to allow the exchange of containers (Pallipane and Rolle, 2008).

Guava has been sorted and cleaned, one by one, wrapped in styrofoam nets, then put in a carton box. The results of Hasiholan (2008) suggested that the techniques can reduce the percentage of mechanical damage during transportation. Mechanical damage of guava that packed with styrofoam net and put in a cardboard box had 39.585% percentage damage, lower than carton packaging without filler material, which is 84.025%.

Exported fruits are generally packed with cardboard boxes (fiberboard), some occasionally use traditional partitions to separate each fruit, with a filler material to prevent mechanical damage (pressure, impact and friction) on fruit. Fiberboard that are used usually coated with wax, which will protect the commodity from water or high humidity for long time periode (Palipane and Rolle, 2008).

Packaging labels must include product information. Shipping labels can contain some or all of the informations, among which

are:

- Common name of product
- Net weight, number and/or volume.
- The name of the brand.
- Name and address of the packer or shipper.
- Country or region of origin.
- The size and grade level (grade).
- Recommended storage temperature.
- Special handling instructions.
- Name of the authorized wax and/or pesticides used on the product.

(Kitinoja and Kader, 2003).

- ***Storage:***

Storage condition can affect the quality of guava, especially temperature, humidity and atmosphere composition during storage. Lien and Shiesh (2010) stated that controlling product temperature is the most important method of slowing quality loss in perishables and extending the shelf life of fruits. Vitamin C levels of guavas that are stored at room temperature (28-32oC) for 10 days has decreased up to 46.35% and the cold temperatures/refrigerator (12-16oC) only decreased up to 39% (Masfufatun et al., 2013).

Guava has a short shelf life and susceptibility to disease and chillling injury. At room temperature, guava ripes rapidly within a few days. Guava is a climateric fruit that have peak respiration

and ethylene production during ripening. Storage at temperatures below 5°C may cause symptoms of chilling injury. Symptoms of chilling injury include failure to mature for green fruit or partially ripe fruit, the brown fruit flesh in some cases, and skin browning. Fully ripe fruits are more resistant to chilling injury than green mature fruit and can be stored for 1 week at 5° C (41° F) without showing symptoms of chilling injury (Kader 2009).

Mature guavas that are green in colour and partially ripe fruits can be stored for 2 to 3 weeks at a temperature of 8-10°C (46 to 50 ° F). The ripe and softened fruits can be stored for 10 days at 5 to 8° C (41 to 46 ° F) with 90-95% RH and a shelf life of about 7 days when stored at 20° C (68° F) (Kader 2009).

Chilling injury and spoilage incidence can be reduced during ripening with Controlled Atmosphere Storage (CAS) compared with storage in air condition room. Christiani (1992), showed that atmosphere composition that was suitable for guava storage were 3-5% O2 and 8-10% C02.

The optimum conditions for storage guavas of "Allahabad Safeda" and "Apple Colour" varieties is 5 kPa O2 + 2.5 kPa CO2; 5 kPa O2 + 5 kPa CO2; 8 kPa O2 and 5 kPa CO2 stored at a temperature of 8 °C with a shelf life up to 30 days. The use of CAS can reduce the rate of respiration and ethylene biosynthesis, delay maturation, reduce chilling injury and

maintain quality. Guava fruit has a high sensitivity to concentrations below 5 kPa O2. CAS enables longs distance shipments of guava for marketing which take 2-3 weeks (Singh and Pal, 2007).

- ***Transportation:***

Transportation is an activity or movement of the harvest of fresh fruit from orchards to the collection and packing house or an effort to distribute or market fresh fruits to consumers. This stage takes quite a long time on the shelf life of fruit, approximately 50- 75% of the shelf life of fruit is spent in transport and distribution. Therefore, maintaining fruit quality during transport and distribution become an important part in the handling of the fruit. Temperature is critical in maintenance of fruit quality. It is necessary to maintain the temperature of the fruit in cold condition (optimum) according to the type of fruit and prevent the effects of external temperature. In other words, it is important to maintain the cold chain during transportation and distribution (Prabawati 2010; Setyabudi, 2010).

Temperature management is very important in long distance transportation, so the cargo should be structured in such a way that it has good air circulation to bring out the heat produced by the products and from the surrounding air. Refrigerated trucks are good transport guava. If refrigerated trucks are not available, the means of transports must be well-insulated so that

the temperature can be maintained and well-ventilated so that air can flow through the product (Kitinoja and Kader, 2003).

Maturity indexes for guava can be selected from the color parameter, texture and sugar acid ratio. Guava are picked at the optimum age to obtain the prime quality. Sorting, cleaning, grading, packaging, storage and transport are a series of post-harvest handling of guava. Edible coating can maintain the shelf life of guavas. Guava must be stored at a temperature of 5-15°C. The use of Control Atmosphere Storage could maintain the shelf life certain varieties of guavas up to 30 days.

Materials and Methods

They were conducted in during 2019-2020 at Sudan university of science and technology- horticulture department to study the effect of backing guava fruits in different containers on fruit shelf life .Guava fruit were backed in six containers and each container was replicated three time.

- Treatment details:

Mature – green fruits of white – and pink – fleshed guava fruits were obtained from an orchard of Mohammed Alhadi Alshaikh at Al-Kadaro, Khartoum North (Lat. 15O40' N, Long. 32O 22' E). Fruits were selected for uniformity of size,colour and freedom from blemishes. The fruits were washed, dried and distributed to six types of containers as flows:

1-control (cartoon boxes plastic box, 15 kg capacity weight)

2-T1 (plastic box, 1-2 kg capacity weight)

3-T2 (plastic box, 4-5 kg capacity weight)

4- T3 (Plastic box, 2-3 kg capacity weight)

5- T4 (Cartoon box, 3-4 kg capacity weight)

6- T5 (Woody box, 14-15 kg capacity weight)

- ***Observations:***

The primary fruit net weight was recorded at the time of backing. then the frequent fruit net weight were recorded after 24(one day),48(Two days),72 (Three days)and 96 hours(Four

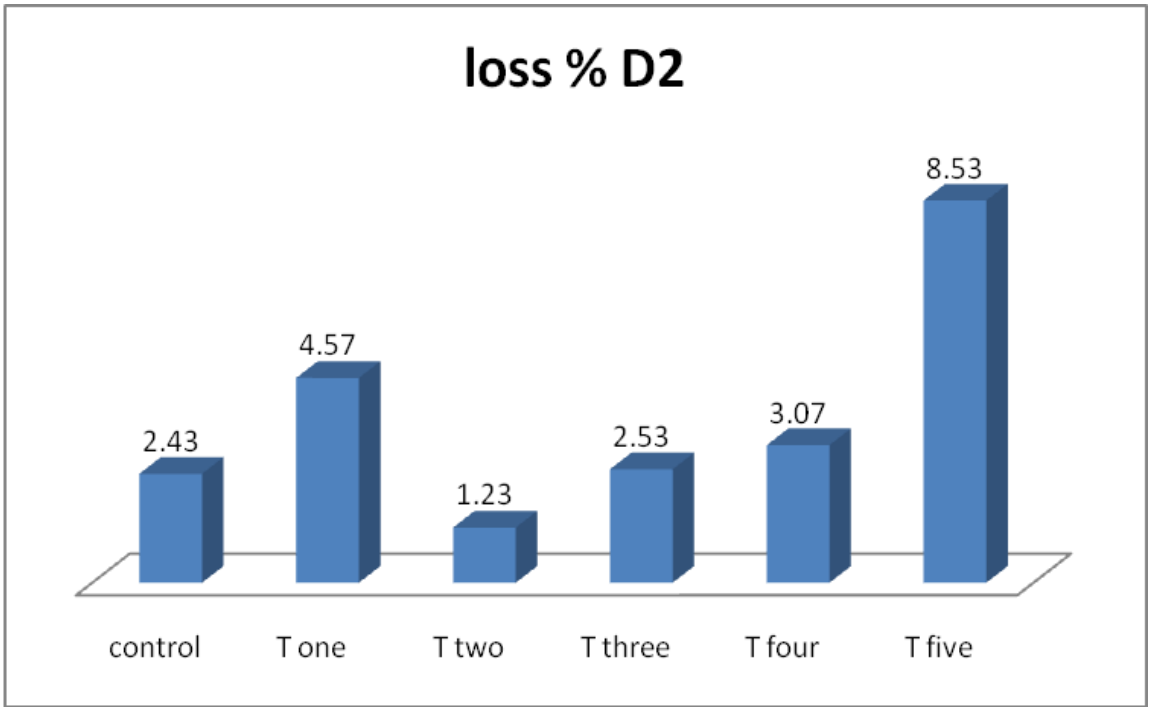
days) to determine the percent of fruit weight loose. Total percent of good and damage fruits were also registered.

- ***Statistical Analysis:***

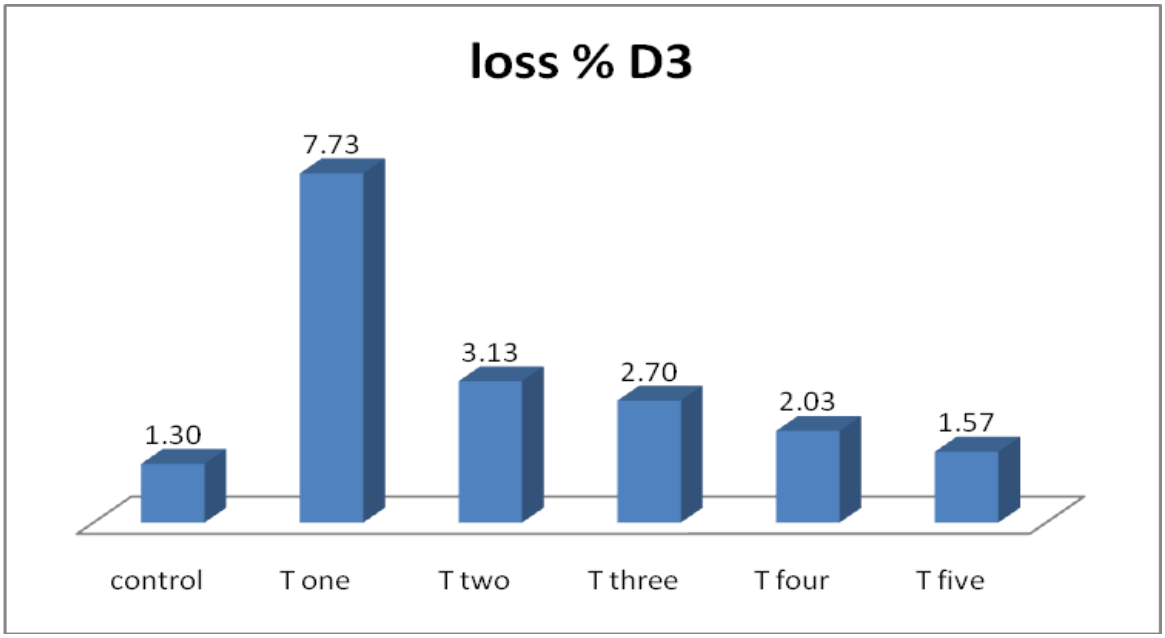
Complete randomized design were used for Analysis of variance (Gomez and Gomez, 1984) followed by Duncan's Multiple Range Test, with a significance level of $P \leq 0.05$ were performed on the data.

Results

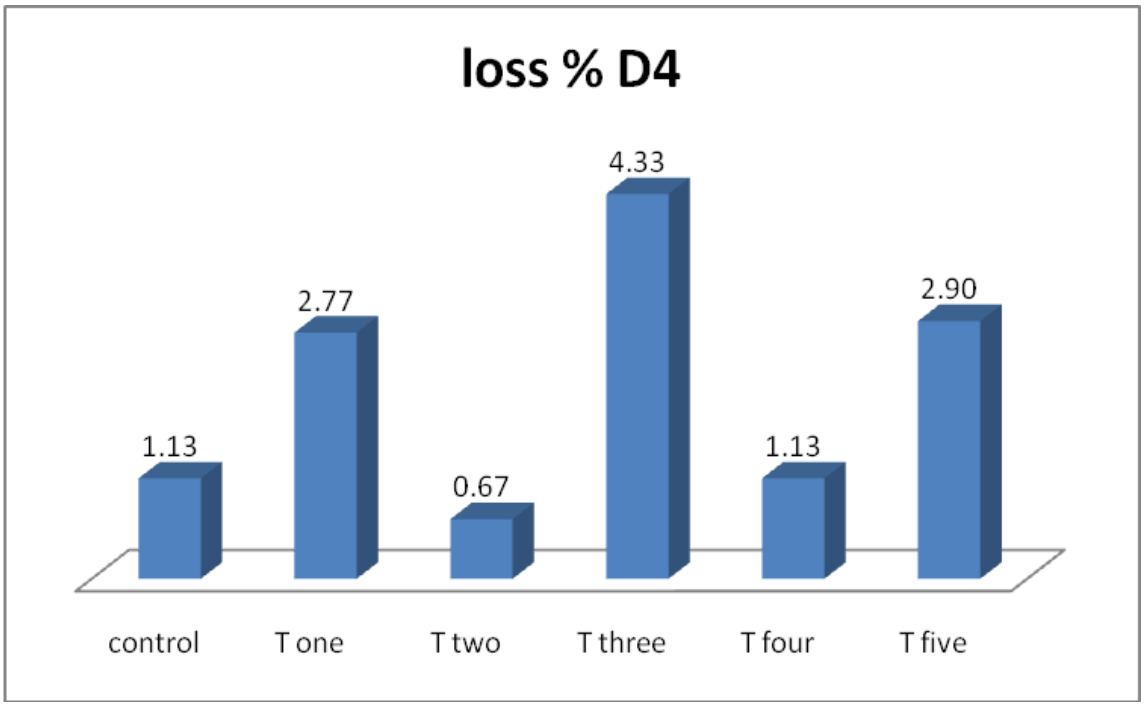
Fruit losses after one day



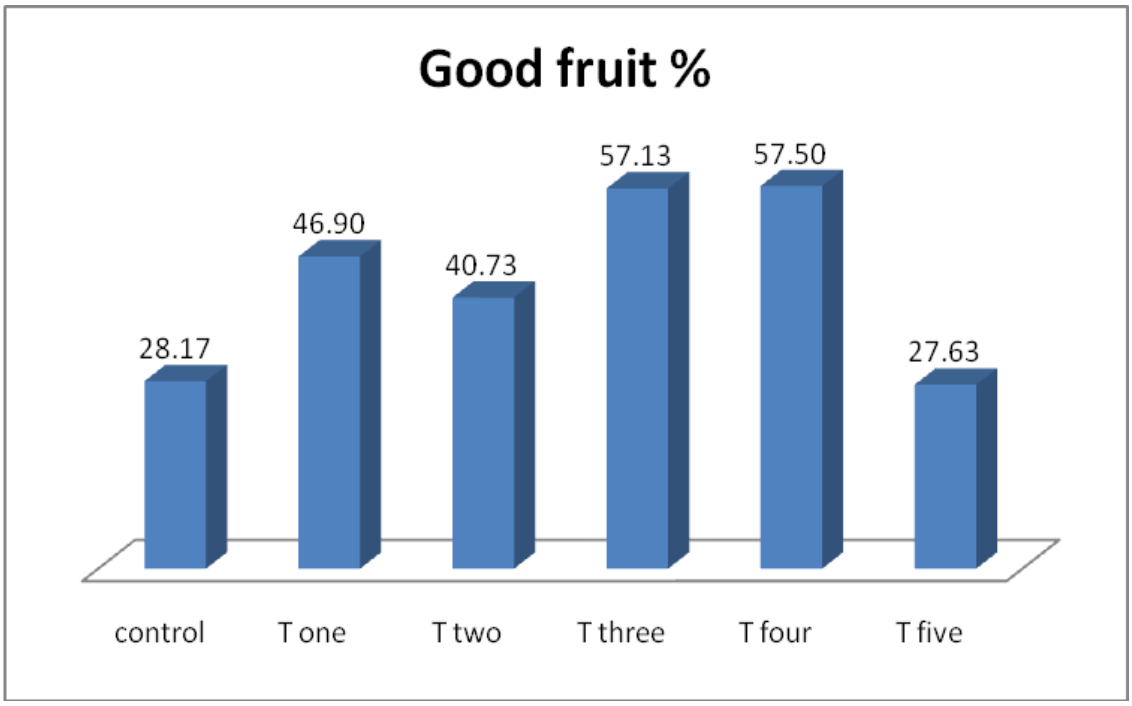
Fruit losses after two days



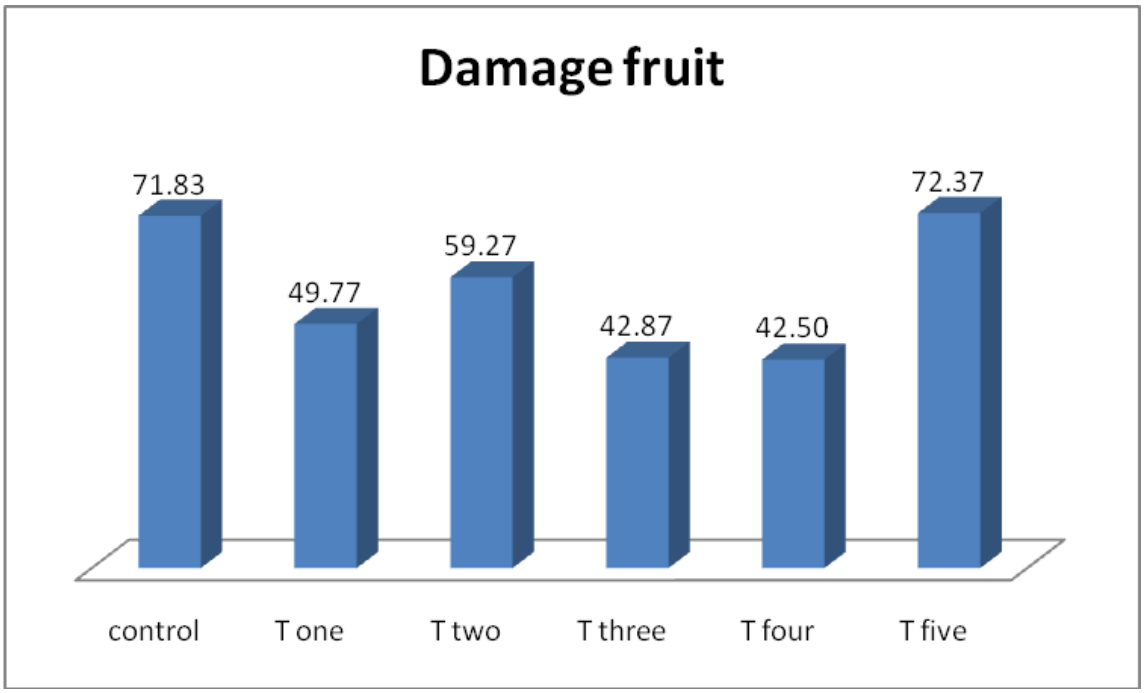
Fruit losses after three days



Total good fruit percent



Total fruit losses percent



Appendix

Table 2. Nutrition content per 100 g of guava.

Amoun	Kind of Nutrition	No
80.8	Water (g)	1.
68.0	Energy (kcal)	2.
2.	Protein (g)	3.
0.	Total of fat (g)	4.
14.3	Carbohydrat (g)	5.
5.	Fiber (g)	6.
228	Vitamin C (mg)	7.
0.	Thiamin (mg)	8.
0.05	Riboflavin (mg)	9.
1.	Niacin (mg)	10.
0.	Vitamin B6	11.
624	Vitamin A, IU	12.
0.	Vitamin E, mg	13.
1	Calsium, Ca (mg)	14.
0.	Ferro, Fe (mg)	15.
2	Magnesium, Mg	16.
4	Phospor, P (mg)	17.
417	Potassium, K (mg)	18.
2	Sodium, Na (mg)	19.
0.	Zinc, Zn (mg)	20.
0.	Cuprum, Cu (mg)	21.
0.	Mangan, Mn (mg)	22.
0.	Selenium, Se (mg)	23.
6		

Source: Nutrition data (2011)

Table 4. Classification of quality of guava according to SNI 7418:2009

QualityClasses		
Super	A	B
Best quality (super) Free from defect except very small on the surface	Good quality. Slight defects of the skin such as abrasions, scratches or other mechanical . damages. The defects do not affect the content of the fruit. Total area of the defect is not more than 5% of the total area of the entire surface of the fruit	Good quality. Slight defects of the skin such as abrasions, scratches or other mechanical damages. The defects does not affect the contents of the fruit. The total area of the defect is not more than 10% of the total area of the entire surface of the fruit.

Table 5. Code of guava size according to SNI 7418:2009 is as follows.

Diameter	Weight (g)	Size code
>100	> 450	1
96-100	351-450	2
86-95	251-350	3
76-85	201-250	4
66-75	151-200	5
54-65	101-150	6
43-53	61-100	7
30-42	35-60	8
<30	<35	9

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