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The Effects of Artificial Ripening (Calcium Carbide) on Pawpaw

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Abstract In recent years, in a bid to cut cost and maximize profit due to the fast spoilage of fruits harvested ripe, farmers have come up with an artificial means to ripen fruits through the use of ripening agents which are relatively detrimental to the human health and also affects fruit quality. This study was therefore carried out to determine the residual effects of calcium carbide on pawpaw fruit quality where calcium carbide of two concentrations (10g and 20g) was administered to two (2) group samples and control sample at (0g). Each concentration of CaC_2 was wrapped in a piece of paper and kept at the bottom of two containers labeled sample A and B. The fruit samples were packed accordingly and covered tightly to limit the leakage of acetylene produced. A drop of water was added to the CaC_2 to release the gas before placing the fruit samples in the container. After 24 hours the wrapped CaC_2 was removed from the containers and allowed to ripen. The control sample was allowed to ripen at room temperature. The findings of this study revealed that sample B gave a higher percentage of moisture (91.33%), protein (0.40%) and crude fiber (0.38). The control sample C, gave higher compositions of crude lipid (0.21%), ash (0.31%) and carbohydrate (11.82%). Sample A and sample B gave higher composition of minerals; sodium (6.21mg and 7.40mg), potassium (25.10mg and 25.32mg), calcium (27.94mg and 28.80mg) and magnesium (10.58mg and 11.74mg) respectively. Sample A gave a higher concentration of vitamin C (36.4%) while a higher content of TTA was recorded in samples A and B (0.17% and 0.19%). pH obtained in this study was high in the sample C (5.30). It was seen that natural means of ripening fruits are much safer than ripening with artificial means which tends to affect fruit quality and pose several health hazards to consumers.

Keywords: *pawpaw, calcium carbide, effects, ripening*

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1. Introduction

Food poisoning due to preservatives used for the processing of certain food items is on the increase in developing countries of Africa where Nigeria a sub set of. Yet, there is inadequate information on the effect of these preservatives on the nutritional status of the food being processed and preserved [1]. Nigeria is the most populous black nation in the world and the most diverse economy emerging market in Africa. Just as it is obtainable in the western worlds, the Nigerian governmental ministries and agencies (National Agency for Food and Drug Administration and Control (NAFDAC), Standards Organization of Nigeria (SON), Federal Ministry of Health, National Codex Committee, Federal Ministry of Agriculture, Consumer Protection Council, States and Local governments) are responsible for developing and maintaining food safety standards and practices. These organizations are supported by several laws and regulations that ensure food safety in Nigeria [2,3].

Fruits contain high amounts of chemically active compounds in particular phenolic compounds. They also contain polysaccharides, sugars, vitamins, minerals and organic acids which provide their wonderful taste and excellent health properties [4]. The presence of antioxidants and other biologically active ingredients in fruits makes them effective in treatment of numerous diseases [5]. Scientific trial results of calcium and vitamin D supplements have proven to be inconsistence, which is indicating that over dependence on this supplements may not be sufficient. Aside taking dairy products, fruits and vegetables intakes have emerged as essential adaptable protective factor for bone health [6].

There are naturally abundant varieties of fruits serving as source of vitamins and minerals for human wellbeing and as well as source of income. Ripening is the change in colour, taste, texture and acidity of fruit involving an organic compound called ethylene (a gas produced by plants from amino acid methionine), which increases amylase and pectinase that produces simple sugars and keeps the fruit hard. Synthetic chemicals are being used to ripen them artificially which hasten the ripening process and make fruits appear fresher or even longer, particularly during early and off-season. Fresh fruits are nutritious, but

toxic artificial ripening agents pose health hazards. The food safety problems posed by artificial ripening agents cannot be ignored, because much more than the benefits, such fruits may result to other harms to the body which may appear overtime [7].

Pawpaw fruit is claimed to have originated from Eastern Central America from Mexico to Panama. However, some suggest it is of South America origin while others claimed it is Central America. It is grown in all tropical and subtropical countries of the world like India, Indonesia, Nigeria, etc [8].

Table 1. Botanical Classification of Pawpaw [9]

Kingdom	Plantae
Class	Magnoliopsida
Superdivision	Spermatophyta
Phyllum	Steptophyta
Order	Brassicales
Family	Caricaceae
Genus	Carica
Botanical name	Carica papaya Linn

Carica papya Linneaus commonly known as pawpaw is a member of the caricaceae family [10]. It has over 22 species and only a member is cultivated as fruit tree [11]. In Nigeria, it is called *Gwandar gida* by the Hausas, *Mgbimgbi* by the Igbos, *Ibepe* by the Yorubas and *Mbuawe* by the Tivs these are the vermacular names different ethnic groups in Nigeria know pawpaw as cited by [12]. The fruit is a power house of nutrients and is grown all through the year. The papaya is a large tree-like plant, with a single stem growing from 5 to 10m (16 ft to 33ft) tall, with spirally arranged leaves confined to the top of the trunk. The leaves are large, 50- 70cm in diameter. The flowers appear on the axils of the leaves, maturing into large fruit. The fruit is ripe when it feels soft and its skin has attained amber to orange hue [12,13]. The fruit is oval in shape possessing a central seed cavity with an edible portion surrounding it. The fruit mature individually in 5-9 months due to the temperature and the harvester [9]. Nutritionally, papaya fruit contains 136/32kj/kcal energy, 91% water, 0.6 g fibre, 0g fat, 0.0 g protein, 8.0 g sugar, 40mg vitamin A, 46 mg vitamin C, 0.03 mg vitamin B1, 0.04 mg vitamin B2, 0.04 mg vitamin B6 [14].

Table 2. Chemical constituents present in various parts of papaya plant [13]

Sn	Phytoconstituents	Part of plant
1.	Enzyme: Papain, Chymopapain	Unripe fruit
2.	Carotenoids: β- carotene, Crytoxanthin	Fruits
3.	Carposide	Roots
4.	Glucosinolates: Benzyl isothiocyanate, papaya oil	Seeds
5.	Minerals: Ca, K, Mg, Zn, Mn, Fe	Shoots, Leaves
6.	Flavanoids: Mycricetin, kaempferol	Shoots
7.	Alkaloids: Carpaine, carpinine, vitamin C and B	Leaves
8.	Monoterpenoids: Linalool, 4-terpinol	Fruits

2. Methodology

Freshly harvested uniformly unripe pawpaw was obtained from effurun market in Uvwie local government of Delta state and calcium carbide was also obtained from the same vicinity in 2021.

A total number of nine (9) fruits were collected and divided into three groups labeled A, B and C three fruits for each replica of the two treatments and the remaining three as control replica. The fruits were washed, cleaned and taken to the laboratory afterwards for sample treatment. Calcium carbide was used as the ripening agent.

The sample preparation was carried out by subjecting fruits to the following treatment: Group A and B were subjected to two levels of calcium carbide concentrations of (10g and 20g) to induce ripening. Group C which served as control (0g) was left in an open temperature without any treatment and allowed to undergo natural ripening for 7 days.

The calcium carbide was weighed using a weighing balance and divided into the weight requirement of each treatment group (10g, 20g, and 0g calcium carbide per fruit) each concentration of the calcium carbide was wrapped in a piece of paper and kept at the bottom of two containers and labeled sample A and sample B. The fruit samples were packed accordingly and covered tightly with newspaper to limit leakage of acetylene produced. A drop of water was added to the calcium carbide to release the gas before finally placing the fruits samples in the container. After 24 hours the wrapped calcium carbides were removed from the containers and the fruit samples were allowed to ripen.

The selected fruits were washed thoroughly to free from mud, ferns and other extraneous material, dried on blotting paper. They were then manually peeled; the peels were cut and washed with running water to remove mucilage. The samples of both the naturally and artificially ripened pawpaw fruit were sent to the chemical laboratory in Edo State for proximate analysis, biochemical and mineral content determination of each of the samples which includes the following parameters; carbohydrate content, total ash, moisture content, crude protein, crude fat, crude fiber, potassium, sodium, calcium, magnesium, vitamin C, pH and total titratable acid (TTA) were carried out. Laboratory procedures was carried out using the Analysis of the Association of Official Analytical Chemists [15] and Laboratory procedures of ASEAN Manual of Food Analysis was used to carry out mineral analysis.

3. Results

3.1. Ripening Time and Conditions

Ripening time differ for the three samples analyzed. The control sample ripened in 7 days at room temperature. While samples A and B ripened in 3 days and 2 days respectively.

Table 3. Pawpaw ripening under different conditions

Samples	Ripening Time
Sample A (10g/kg CaC_2 conc.)	3 days (72 hours)
Sample B (20g/kg CaC_2 conc.)	2 days (48hours)
Sample C (Control)	7 days (168 hours)

3.2. Proximate Composition

Table 4. Proximate composition of naturally ripened and calcium carbide ripened Pawpaw fruit

Proximate analysis parameters (%)	Carbide ripened pawpaw fruit Sample A (10g)	Carbide ripened pawpaw fruit Sample B (20g)	Naturally ripened pawpaw fruit Sample C (0g)
Moisture	90.10	91.33	87.35
Crude Protein	0.38	0.40	0.29
Total Ash	0.21	0.23	0.31
Crude Fibre	0.36	0.38	0.30
Crude Lipid	0.18	0.18	0.21
Carbohydrate	6.90	7.41	11.82

Key: CaC_2 = Calcium carbide, Sample A = CaC_2 ripened fruit (10g) treated, Sample B = CaC_2 ripened fruit (20g) treated, Sample C = Control (natural).

The effect of different ripening acceleration method on the proximate composition of pawpaw (Table 4) revealed that sample B gave higher moisture content (91.33%) followed by sample A (90.10%) and sample C (87.35%). Sample A and B from the results obtained also indicated an increase in protein concentration of (o.38% and 0.40%). Total ash content analyzed was high in sample C (0.31%) and slightly low in sample A and B (0.21% and 0.23%). Similarly, carbohydrate content was high in the sample C (11.82%) and lower for the other two samples (6.90% and 7.41%) analyzed. Fat contents analyzed had equal values for both samples A and B (0.18%) and (0.21%) for sample C. Crude fiber contents analyzed was low in sample C (0.30%).

3.3. Mineral Composition

Table 5. Mineral composition of naturally ripened and calcium carbide ripened pawpaw fruit

Minerals (mg)	Carbide ripened pawpaw fruit Sample A (10g)	Carbide ripened pawpaw fruit Sample B (20g)	Naturally ripened pawpaw fruit Sample C (0g)
Sodium Na	6.21	7.40	5.95
Potassium K	25.10	25.32	20.51
Calcium Ca	27.94	28.80	27.50
Magnesium Mg	10.58	11.74	9.20

Key: CaC_2 = Calcium carbide, Sample A = CaC_2 ripened fruit (10g) treated, Sample B = CaC_2 ripened fruit (20g) treated, Sample C = Control (natural).

The mineral content showed in Table 5, calcium was the most predominant in the sample B (20.80 mg), sample A (27.94 mg) and sample C (27.50 mg), followed by potassium (25.32 mg, 25.10 mg and 20.51 mg respectively), magnesium (11.74 mg, 10.58 mg and 9.20 mg respectively) and sodium being the least concentration, showed (7.40 mg, 6.21 mg and 5.95 mg respectively).

3.4. Biochemical Composition

Table 6. Biochemical composition of naturally ripened and calcium carbide ripened pawpaw fruit

Biochemical Parameters	CaC_2 ripened pawpaw fruit Sample A (10g)	CaC_2 ripened pawpaw fruit Sample B (20g)	Naturally ripened pawpaw fruit Sample C (0g)
p^H	4.80	5.10	5.30
TTA (%)	0.19	0.17	0.13
Vit. C (mg/100g)	34.1	34.8	36.4

Key: CaC_2 = Calcium carbide, Sample A = CaC_2 ripened fruit (10g) treated, sample B = CaC_2 ripened fruit (20 g) treated, sample C = Control (natural), TTA = Total titrable acid, vit. C = Vitamin C.

Vitamin C content analyzed in the samples as shown in Table 6, was similar in sample A and B (34.1 mg/100 g and 34.8 mg/100 g respectively). Similarly, the results obtained for pH analysis was similar in samples B and C (5.10 and 5.30). TTA analyzed was found to be lower in sample C (0.13%).

4. Discussions

From Table 3 above, it is seen that the fruits treated with 20g of calcium carbide, ripened in the space of 2 days (48hours) while the sample treated with 10g of calcium carbide, ripened within 3 days (72hours). The sample C which was allowed to ripen naturally took about 7 days (168 hours) to ripen completely. This result agrees with [16] when evaluating the effects of calcium carbide on some selected fruits. In the same way, [1,17] also reported of how calcium carbide especially in high concentration hastens the ripening time of fruits when compared with natural ripening. The calcium carbide ripened sample represents about 43% reduction in ripening time compared to the natural process [18]. It is seen from the results that ripening with calcium carbide requires less time which can easily lead to fruit spoilage and deterioration.

4.1. Moisture

The effects of natural and artificial ripening on the proximate composition of pawpaw revealed that carbide treatment (20g) gave a higher percentage composition of moisture (91.33%) while sample B (10g) was in close range (90.10%). The control (0g) which was the naturally ripen one had a lower percentage (87.35%). In fruits, moisture content can have a significant effect on factors such as taste, texture, appearance, shape and weight. Thus, excess water in a fruit as reported by [19] will lead to an increase in microbial growth and decreased shelf life which will lead to quick deterioration or spoilage of the fruit.

4.2. Crude Protein

Protein content increase during pawpaw ripening is likened to the increase of the enzymes and protein

synthesis conversion. Protein synthesis is an important aspect of fruit ripening [19]. In these findings, there was a decline in protein content in the pawpaw fruit that was naturally ripened (0.29%) and an increase in the corresponding samples ripened artificially (0.38 and 0.40%). This is in agreement with [16] and [19], where they observed a reduction of protein content. [20], observed higher values for protein content in ripe pawpaw of (6.1%).

4.3. Total Ash

The ash contents which relates to inorganic minerals present, when analyzed, the sample C showed a higher composition of ash (0.31%) compared with sample A and B which had the compositions (0.21 and 0.23%). This indicates the availability of minerals in the fruit which are found higher in naturally ripened pawpaw fruit. Increased concentration of ash shows that pawpaw would make available necessary minerals to the body [19]. According to [21], artificially ripened fruits possess less Ash content than naturally ripened fruits which is in agreement with the present study.

4.4. Crude Lipid and Crude Fiber

Lipid content in the samples was relatively high in sample C and equal for both samples A and B. This did not tally with what [16] reported. His report indicated an increase in lipid content during natural ripening. Fiber content values for sample B was high compared with naturally ripened one. The main role of fiber is to keep the digestive system healthy. The whole papaya fruit is an excellent source of dietary fiber and therefore can also help in h preventing the constipation.

4.5. Carbohydrates

Carbohydrate content in the natural sample was high (11.82%). The values in the carbide ripened samples were (6.90 and 7.41%). This reveals a reduction of carbohydrate content with an increase in carbide concentration. These findings were similar to those of [16,19]. This can be traced to increase in respiration rate caused by the production of acetylene. Increase in carbohydrate content indicates that the fruit is a good source of energy.

4.6. Mineral Composition

All mineral contents analyzed in the natural ripened sample (A) indicated a decline in their various parameters (potassium 20.5 mg/kg, sodium 5.95 mg/kg, calcium 27.50 mg/kg and magnesium 9.20 mg/kg). There was a higher value for the minerals present in an unripe pawpaw fruit as stated by [12]. However, [22] in their study, reported that fruits are generally low in mineral constituents but when taken in sufficient quantities, could serve as a reliable source. Pawpaw fruits are very nutritious. They are high in magnesium, iron, copper, and manganese. They are a good source of potassium and several essential amino acids, and they also contain significant amounts of riboflavin, niacin, calcium, phosphorus, and zinc. Pawpaw contains these nutrients in amounts that are generally about the same as or greater than those found in bananas, apples, or oranges [9].

4.7. Biochemical Composition

4.7.1. Total Titratable Acid (TTA)

Fruits in its unripe state contain different forms of organic acid which gives the fruit its sour taste but the acids are changed into sugar during the ripening process [23]. Total titratable acidity (TTA) is an indication of the amount of acid present in a fruit. Total acidity of pawpaw fruit from the study in sample A and B was 0.19 and 0.17%, while the sample A was 0.13%. TTA of the natural and accelerated ripened pawpaw fruits were slightly different from one another. The result also indicated that ripening reduced the total titratable acidity of the fruits and this was more revealed with natural ripened fruits as reported by [9] for unripe pawpaw fruit as (20.90%). The decrease in acidity is due to susceptibility of the predominant acid to oxidative destruction as influenced by the ripening environment. It might also be due to their utilization as substrates for respiration [7]. Fruits with high acidity have been reported to have implications to dental health as they might cause dental erosion, especially among children [24]. Acidity levels of the control sample were low compared to accelerated ripened fruit sample. Pawpaw is a low acid fruit, with TTA as 0.1% [25]. A study by [26], revealed that there was an increase in acid content of the samples ripened naturally compared to the treated sample, which does not agree with our results.

4.7.2. Vitamin C

Vitamin C content values seen from the Table 4, is higher (36.4 mg/100 g) compared to the samples ripened with calcium carbide concentrations of 10g and 20grams respectively (34.1mg/100g and 34.8 mg/100 g). [16] reported a high vitamin C content in naturally ripen fruit samples (50 mg) and fruit samples ripened at different carbide concentrations, ranged from (42mg-45mg) which indicated a decline in vitamin C content when fruits are ripened with calcium carbide. Another research by [9] reported that pawpaw fruits are a good supply of vitamin C and A. It ranks first among 13-17 fresh fruits for vitamin C content. The vitamin C content in this study was lower compared with values obtained in other research. Also, [19] reported values ranging from (35mg-41mg) which was slightly in close range with the results obtained in (Table 6) above.

4.7.3. pH

The pH contents observed in Table 4 above, showed a pH value for sample A as (5.30), while sample B (4.80) and sample C (5.10). All the samples analyzed fell within acidity range of the pH scale. According to [25] ripened pawpaw fell within the range of 5.20 – 6.00 which corresponds with the value obtain for the control sample C (5.30) in this research.

5. Conclusion

The effects of artificial ripening (Calcium carbide) on the properties of pawpaw fruit have been determined. This study confirms other reports in similar studies or research works that artificial ripening facilitates ripening process and it is very detrimental to the nutritional quality of the fruits. This study has revealed that the artificial ripening of pawpaw with calcium carbide has resulted in the alteration of most physical and chemical constituents of the fruit. From the results seen, the calcium carbide ripened pawpaw fruits showed a great decline in the fruit quality. Hence, natural ripening is in high preference compared to calcium carbide ripened fruit not just because of its flavor and appearance but also because of its great contribution to the overall health of its consumers. The determination of the effects of calcium carbide on pawpaw fruit quality enables for better understanding of its health effects and nutritional values. Therefore, fruit ripening with calcium carbide should be addressed with utmost seriousness. The government agencies, policy makers, farmers, fruit sellers, scientists and consumers are parties involved on this aspect of the fruit industry.

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References

[1] Adewole MB, & Duruji RW. Quality Assessment of plantain (*Musa paradisiaca* L.) as affected by different ripening methods. *African Journal of Biotechnology*, 2010; *9*(38): 6290-6293.

[2] Nyor JT. The role of regulatory agencies in food quality control in Nigeria. SCSR J Agribus. 2014; 1(1): 01-5.

[3] Omojokun J. Regulation and enforcement of legislation on food safety in Nigeria. In: Makun HA, editor. Mycotoxin and food safety in developing countries. INTECH Publication; 2013; ISBN 978-953-51-1096-5.

[4] Hui YH, Barta J, Cano MP, Gusek TW, Sidhu JS and Sinha NK. Handbook of Fruits and Fruit Processing. USA: Wiley-Blackwell, 2006.

[5] Habauzit V and Horcajada MN. Phenolic phytochemicals and bone. Phytochemistry Reviews, 2008; 7: 313-344.

[6] Tucker KL. Osteoporosis prevention and nutrition. Current Osteoporosis Reports, 2009; 7: 111-117.

[7] Abhishek RU, Venkatesh HN, Manjunath K and Mohana DC. Artificial ripening of fruits—misleading ripe and health risk. *Everyman's Science*, 2016*;* 6 (1): 364-369.

[8] Anitha , B, Raghu N, Gopenath TS, Karthikeyan M, Gnanasekaran A, Chandrashekrappa GK & Basalingappa KM. Medicinal Uses of *Carica papaya*. Journal of Natural and Ayurvedic Medicine, 2018; 2(6): 000144.

[9] Yogiraj V, Goyal PK, Chautian CS, Goyal A & Vyas B. *Carica papaya* Linn: An Overview. *International Journal of Herbal Medicine*, 2014; *2*(5): 01-08.

[10] Ayoola PB, Adeyeye A. Phytochemical and Nutrient Evaluation of *Carica papaya* (Pawpaw) Leaves. *IJRRAS, 2010; 5*(3): 325-328.

[11] Oyeleke GO, Isola AD, Salam & Ajao FD. Evaluation of some chemical composition of pawpaw (*carica papaya*) seeds under normal storage ripening. *IOSR Journal of Environmental Science Toxicology and Food Technology (IOSR-JESTFT), 2013; 4*(6), *e.ISSN*: 2319-2402, p-ISSN: 2319-2399.

[12] Daagema AA, Orafa PN & Igbua FZ. Nutritional Potentials and Uses of Pawpaw (Carica papaya): A Review. *European Journal of Nutrition and Food Safety*, 2020; *12*(3):52-66.

[13] Aravind G, Bhowmik D, Duraivel S & Harish G. Traditional and Medicinal uses of *Carica papaya*. *Journal of medicinal plant studies*, 2013; *1* (1), 7-15.

[14] Kazi NA, Yadav JP, & Agale MG. Nutritional value of fruits. *Schorlarly Research Journal for Interdisciplinary Studies*, 2015; *3*(16): 2937-2943.

[15] AOAC. *Official methods of analysis of the association of official Analytical Chemists*, 15th ed., Association of Official analytical Chemists, Arlington VA, 2002; 1058-1059.

[16] Adeyemi MM, Bawa MH & Muktar B. Evaluation of the Effect of Calcium Carbide on Induce Ripening of Banana, Pawpaw and Mango cultivated within Kaduna Metropolis, Nigeria. *J. Chem Soc. Nigeria*, 2018; *43(2):*108-118.

[17] Singal S, Kumud M & Thakral S. Application of apple as a ripening agent for banana. *Indian Journal of Natural Products and Resources*, 2012; 3(1): 61-64.

[18] Gimba JD, Chundusu ES & Chup JA. Comparative Chemical Analysis of the Nutritional Values of Artificially and Naturally Ripened Banana and Paw Paw Friuts. CARD International Journal of Medical Science and Applied Biosciences (IJMSAB), 2017; 2(2): 36-45.

[19] Iroka CF, Akachukwu EE, Adimonyemma RN, Okereke NC & Nwogiji CO. Effects of Induced Ripening on the Proximate, Biochemical and Mineral Compositions of *Carica papaya* (Pawpaw Fruit). *European Journal of Medicinal Plants*, 2016; 15(3): 1-10.

[20] Maisarah AM, Asmah R, Fauziah O. Proximate Analysis, Antioxidant and Anti Proliferative Activities of Different Parts of Carica papaya. J Tissue Sci Eng, 2014; 5: 133.

[21] Mahmood T, Iftekhar S, Humer A & Iffat M. Comparative Study to Evaluate the Effect of Calcium Carbide (CaC2) As an Artificial Ripening Agent on Shelf Life, Physio-Chemical Properties, Iron Containment and Quality of Prunus persica. *European Academic Research, I1*, 2013; (5): 286-292.

[22] Slavin JL & Lloyd B. Health Benefits of Fruits and Vegetables. *American Society for Nutrition.* Adv. Nutr. 2012; 3: 506-516.

[23] Essien EB, Onyegeme-Okerenta BM & Onyema JO. Calcium Carbide as an Artificial Fruit- Ripening Agent and its Physiological Effects on Wistar Rats. *Clinical and Experimental Medical Sciences*, 2018; 6(1): 47-61.

[24] Jindal T, Agrawal N & Sangwan S. Accidental Poisoning with calcium carbide. J Clinic Toxicol, 2013; 3: 159.

[25] USDA (United States Department of Agriculture), Agricultural Research Service (2009). National Nutrient Database for Standard Reference, Release 22, Nutrient Data Laboratory Home Page, http://www.ars.usda.gov/ba/bhnrc/ndl.

[26] Dhembare AJ. Bitter truth about fruit with reference to artificial ripener. *Archives of Applied Science Research*, 2013; 5 (5):45-54.