

Research Application Summary

**Adding value to pineapple: The potential of fruit juice preparation**

Smith, O. K.<sup>1</sup>, Abano, E. E.<sup>1,3</sup> & Annor-Frempong, F.<sup>2</sup>

<sup>1</sup>Department of Agricultural Engineering, School of Agriculture, University of Cape Coast, Ghana

<sup>2</sup>Department of Agricultural Economics and Extension, University of Cape Coast, Ghana

<sup>3</sup>Marven Foods Company Limited, P. O. Box EL261, Elmina, Ghana

**Corresponding Author:** [oforiwaahkukuwaa@gmail.com](mailto:oforiwaahkukuwaa@gmail.com)

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**Abstract**

Post-harvest losses are a major threat to development of pineapple value chain but there is the potential of adding value by processing into juice. The review analysed relevant literature on adding value to pineapple, potential of processing pineapple into fresh juice and reducing the post-harvest losses by producers as thematic areas. AGORA, Research Gate and Google Scholar software were used to select ten papers that met the inclusion criteria. Content analysis technique was used to examine three studies based on the major and sub-themes. The results showed that freshly processed fruit into juice can be stabilized using thermal processing, freezing, refrigeration and vacuum packaging. Freshly produced juice can retain its quality up to 12 months when stored at temperature of -18 °C. Key challenges in the processing of fruits included technical, infrastructural and institutional issues. The study concludes that there is the possibility to prepare fruit juice from pineapple to add value and reduce post-harvest losses. However, there is the need to ensure chemical and microbiological safety of fruits and present juice in convenient form. Texture, taste, color and flavour quality concerns should be addressed. The constituents of pineapple, juice stabilization, packaging and storage are key aspects of value addition.

Keywords: Pineapple, juice, post-harvest processing, post-harvest losses, value addition

**Résumé**

Les pertes post récolte sont une menace majeure pour la chaîne de valeur de l'ananas, mais il y a un potentiel de valorisation, à travers sa transformation en jus. La revue a analysé les informations disponibles dans la littérature sur la valorisation de l'ananas, le potentiel de sa transformation en jus frais et la réduction des pertes post récolte par les producteurs. Les bases d'informations telles que AGORA, ResearchGate et Google Scholar ont été utilisées pour sélectionner dix articles répondant aux critères d'inclusion sus-indiqués. La technique d'analyse de contenu a été utilisée pour examiner trois études basées sur le thème principal et les sous-thèmes. Les résultats ont montré que les fruits fraîchement transformés en jus peuvent être stabilisés par traitement thermique, congélation, réfrigération et emballage sous vide. Lorsqu'il est conservé -18 °C, le jus d'ananas frais peut conserver sa qualité pendant 12 mois. Les principaux défis liés à la transformation des fruits d'ananas sont

les difficultés techniques, infrastructurelles et institutionnelles. L'étude conclut qu'il est possible de préparer du jus à partir de l'ananas pour le valoriser et réduire les pertes post récolte. Cependant, il est nécessaire d'assurer la sécurité chimique et microbiologique des fruits et que les jus soient présentés sous une forme convenable. Les aspects tels que la texture, le goût, la couleur et la saveur du jus doivent être pris en compte. Les constituants de l'ananas, la stabilisation du jus, l'emballage et le stockage sont des aspects clés de sa valorisation.

Mots clés: Ananas, jus, transformation post récolte, pertes post récolte, valorisation

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## Introduction

Pineapple is an important tropical crop and can be eaten fresh or processed into a fruit juice (Sripaoraya *et al.*, 2003). Pineapple is a non-climacteric fruit that does not have autocatalytic ethylene burst for ripening (Moyle *et al.*, 2005). Pineapple is native to southern Brazil and Paraguay but Costa Rica is ranked first in the production of pineapple with 2,930 thousand metric tons (FAO, 2016). In Ghana, pineapple production is widespread but mostly found in Eastern, Central and Western regions (Abano, 2010).

Pineapple fruit juices are consumed due to the refreshing attributes, nutritive values and health benefits (Nwachukwu and Ezejiaku, 2014). Fruit juices are an important source of bioactive compounds and have essential physical, chemical, organoleptic, and nutritional characteristics (Esteve and Frigola, 2007). The healthy, low-fat and nutritious content makes pineapple juice a choice beverage (Dennison, 2013). Pectin and cellulose content of juice stimulate intestinal activities, provide energy (oil fat and proteins) and medicinal values (Joy and Minu, 2013). Previous studies conducted on postharvest losses of fruits and vegetables in Ghana show that more than 50% of the farm produce go to waste during peak harvest due to high perishability of fruits and inadequate farmer's knowledge regarding processing, packaging and storage (Abano *et al.*, 2013). Ghanaians prefer to consume freshly made fruit juice. However, consumers are becoming increasingly aware of the need to consume fresh fruit juices without artificial additives, preservatives, sugars, among others, due to diabetes, obesity, cardiovascular diseases, and neurological disorders. Therefore, there is a need to provide fresh fruit juices which can serve as functional foods for changing lifestyle of consumers. Processing fresh fruits into juice without additives and preservatives, packaging and storage add value and enhance shelf life of fruits. However, this remains a global challenge as more analysis are needed to obtain better processing, preservation and promote longevity of pineapple juice. This study used meta-synthesis in analyzing the potential of processing pineapple into fresh juices and reducing post-harvest losses by producers.

The following research questions guided the in-depth analysis of the study; What are the available value addition options for pineapple?; Do producers have challenges in harvesting and storing pineapples?; Does processing of pineapple reduce post-harvest losses?; Will pineapple juice contribute to reduce post-harvest losses?; What methods could be used to store and stabilize the pineapple juice?; and What will be the effect of packaging materials on the pineapple juice?

**Methods**

**Search procedure.** The review was done using a range of databases that contained relevant sources of information. Series of search sites comprising online database, websites and number of available information from TEEAL, AGORA, Research gate, Elsevier and Google Scholar were visited. The search portals allowed the examination of a number literature from appropriate writers. The Boolean operators ‘‘OR’’ and ‘‘AND’’ were used to limit the search and focus on relevant publications on the research topic. Some of the search terms used were pineapple processing and preservation, benefits of fruit juice, post-harvest of pineapple, potential of pineapple juice and value addition to pineapple. The search terms were used to recover information per the inclusion criteria.

**Inclusion criteria.** Literature from Google scholar, websites, Research Gate and AGORA were used for the study in which terms used for the search were specific in order to extract relevant publications to the topic. Studies that reported findings on pineapple juice preparation and other fruits combination together with pineapple juice and are relevant to the topic were accessed. The search narrowed the documents to ten for the sake of relevance and focus.

**Exclusion criteria.** Wide range of results published from 2003 to 2016 came up during the search and about 10 results materials were chosen of which three fell exactly within the inclusion criteria. Journals and articles that did not emphasize pineapple or pineapple processing were excluded. Journals and articles selected were all published in English language.

**Data analysis.** Relevant themes on adding value to pineapple and the potential of juice were extracted using the thematic analysis. The major theme and sub-themes were obtained from value addition to pineapple and pineapple juice. Designated research were analyzed based on the extent to which particular theme of their work were addressed (Table 1).

**Results and Discussion**

Table 2 and 3 present results of selected studies and themes under discussion with respect to the study interest. The thematic analysis permitted to have major themes which directly communicates the study interest and sub-themes to back and elaborate more on the themes under discussion. Table 3 present results of studies that reported on a given general theme and sub-theme. The (●) mark in the boxes indicates a particular study reported on a given theme. The blank boxes indicate the study not reporting on the given theme.

**Table 1. General theme and the sub-themes of the study interest**

General theme	Juice making as value addition to pineapple
Sub-themes	<ol style="list-style-type: none"> <li>1. Issues with fruit processing to juice</li> <li>2. Juice stabilization</li> <li>3. Packaging and storage</li> <li>4. Constituent of pineapple juice</li> </ol>

**Table 2. Selected relevant studies examined in relation to pineapple juice**

Author and date	Research method	Specific case/ Country	Publication type	Topic
R. S. Rolle, 2006	Comparative analysis	Rome, Italy	Edited book	Processing of fruits and vegetables for reducing post-harvest losses and adding value.
E. Nwachukwu and F.C.Ezejiaku, 2014	Experiment	Nigeria	Journal article	Microbial and physicochemical characteristics of locally produced pineapple juice treated with garlic and ginger
P. P Joy and A. M. Abraham, 2013		Muvattupuzha, Ernakulam, Kerala, India	Technical report	Fruits, benefits, processing, preservation and pineapple recipes

**Table 3. Results of selected relevant studies on processing pineapple juice**

Author and date	Country	Issues with fruit processing to juice	Juice stabilization	Packaging and storage	Constituents of pineapple Juice
R. S. Rolle, 2006	Rome, Italy	●	●	●	
E. Nwachukwu and F.C.Ezejiaku, 2014	Nigeria				●
P. P Joy and A. M. Abraham, 2013	Muvattupuzha, Ernakulam, Kerala, India	●	●	●	

**Issues with fruit processing to juice.** Pineapple fruits need to be processed to make them durable due to the high perishability of fruits (Joy and Minu, 2013). There are three major aims for fruit processing namely:

*Ensuring chemical and microbiological safety of fruits.* Microbiological and chemical processing activities including cleaning and washing, sorting, blanching, cutting, juicing among others can make fruit safe. Processed fruits if treated and handled well halt or

slow down fruit spoilage, edibility, and loss of quality or nutritional value. The safety involves preventing the growth of bacteria, fungi, yeast and other micro-organisms as well as retarding oxidation of fat which causes products rancidity. Some activities that can be undertaken to make fruit safe includes boiling where moisture content of fruits are reduced and bacteria killed. Furthermore, sugaring prevent re-growth, and sealing within air tight jars/bottles prevent product contamination. Lowering temperature is another technique to ensure fruit safety because it reduces the respiration rate of fruits and retards spoilage since at that temperature, microbial growth is almost stopped.

*Provision of good quality products with good texture, taste, color and flavour*

Texture and flavour are key to the maintenance and/or creating of nutritional value. Vacuum packaged fruit juice stores longer and there is reduced flavour loss during oxidation thereby maintaining the quality of the product.

*Making fruits products convenient.* According to Rolle (2006) processing fruits into juice increases the market opportunities and adds value. Furthermore post-harvest losses are minimized, profitability, viability and sustainability of fruit are improved leading to increased farm incomes, foreign exchange earnings and rural employment. The increasing urbanization and opening of access to the world marketplaces under globalization have raised demand for quality, convenience, storage and safety characteristics of processed fruit. Small and Medium Scale Enterprises engaged in processing of fruit are challenged in meeting benchmarks such as international standards of good manufacturing practice (GMP), HACCP certification, labelling and quality assurance, packaging and environmental standards. A number of technical, infrastructural and institutional issues negatively impact on fruit processing operations. The technical issues include; low processing efficiency, inadequate quality control systems and inappropriate processing equipment. The institutional constraints are mostly due to technical issues and include limited access to external inputs, and inconsistent and insufficient supplies of high quality raw materials. There is also limited marketing infrastructure.

*Constituents of pineapple juice.* Adults and children widely consume pineapple juice which is a non- alcoholic drink. Demand continues to rise mainly due to increasing consumer awareness of health benefits. The composition of juice has implications for value addition. The juice is composed of 81.2-86.2% moisture, 13-19% total soluble solid of which sucrose, glucose, and fructose are the main components. Furthermore there is 0.4% fibre and a rich source of vitamin C. Lipids and nitrogenous compounds constitute about 0.2%. The pH ranges from 3.7-4.5 with titratable acidity of less than 1.2 (Nwachukwu and Ezejiaku, 2014).

*Juice stabilization.* Processing technologies such as thermal processing (bottling and canning), and freezing are generally applied in fruits processing. Specialized packaging, slight processing technologies, and natural preservation systems are gradually being applied in fruits preservation for developed and developing country markets. There is increasing consumer demand for convenience and for “fresh-like” fruits of high quality (very nutritious, flavourful and stable). Processing technologies focus on value addition with comparatively little product transformation but increasing product diversity. Thermal

processing technology is the key technology applied in the shelf-stable preservation of fruits. Thermal processing can be carried out at different range of technical levels and is widely applied in production of canned and bottled fruits, juice, jellies and jams. Freezing is also equally widespread technology that causes minimal changes in texture, flavour and color of food products. Freezing require high energy for freezing operations and thereby increasing the product cost (Rolle, 2006). Joy and Minu (2013) emphasized on preservation of juice using refrigeration, freezing, pasteurization and vacuum packing to slow down growth of micro-organisms and enzymes action.

*Packaging and storage.* Fresh fruits are highly perishable and must be packaged and stored to reduce production losses which averagely range between 24 and 40% in most developing countries, and between 2 and 20% in developed countries. This level of waste result in higher pricing of fresh fruit produce and fruit juice. Packaging is very important in protection of fresh fruit produce or juice. Packaging reduces microbial contamination from surrounding environment and consumer contact and extends the post-harvest shelf-life. Packaging increases the freshness of the juice or fruit and finally, increases the sale of fresh produce. Quality of fruit processed can be retained for up to 12 month, when stored at -18 °C. The quality of keeping frozen products is, however, dependent on storage conditions (Rolle, 2006). Some of the packaging methods are canning, bottling (plastic, glass) and paper package. Glass bottles and jars should be kept away from light when used to store juice and fresh fruit produce. Juice should be stored at consistent temperature and dry place (Joy and Minu, 2013).

### **Conclusions and implications**

Value addition of pineapple involves microbiological and chemical processing activities (cleaning and washing, sorting, blanching, cutting, and juicing). Processed fruits halt fruit spoilage and loss of nutritional value. Boiling reduces and kill bacteria, sugaring prevents re-growth whilst air tight sealing prevents product contamination. Lowering temperature reduces respiration rates of fruits and microbial growth. Quality products have good texture, taste, color and flavour. Vacuum packaged fruit juice stores longer.

The challenge to value addition is meeting international benchmarks for labeling and quality assurance, packaging and environmental standards. There are technical, infrastructural and institutional issues that negatively impact on fruit processing operations and value addition. The paramount are technical issues such as low processing efficiency, inadequate quality control systems and inappropriate processing equipment.

The composition of juice namely moisture and sugars has implications for value addition. Processing technologies focus on value addition with comparatively little product transformation but increasing product diversity. Packaging increases the freshness of the juice and can be stored at -18 °C for up to 12 months.

We conclude that there is high potential for improved fruit juice preparation to add value to pineapple and reduce post-harvest losses. This implies that issues with fruit processing into juice such as ensuring chemical and microbiological safety of fruits should be addressed.

There is also the need to make fruits products convenient, with good qualities such as texture, taste, color and flavour. The constituents of pineapple juice, juice stabilization, packaging and storage are very important considerations.

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### References

- Abano, E. E. 2010. Assessment of drying characteristics and physio-organoleptic properties of dried pineapple slices under different pre-treatments. *Asian Journal of Agriculture Research* 4 (3): 155-161.
- Abano, E. E., Owusu, J. and Engmann, F. N. 2013. Microwave-Vacuum drying effect on drying kinetics, lycopene and ascorbic acid content of tomato slices. *Journal of Stored Products and Postharvest Research* 4 (1): 11-22.
- Dennison, B. A. 2013. Fruit juice consumption by infants and children: a review. *Journal of the American College of Nutrition* 15 (5 Suppl): 4S-11S.
- Esteve, M. J. and Frigola, A. 2007. Refrigerated juices: Quality and safety issues. *Advances in Food and Nutrition Research* 52: 103-139.
- Joy, P. P. and Minu, A. 2013. Fruits benefits, processing, preservation and pineapple recipes. Kerala Agricultural University. 20pp. available at [https://www.researchgate.net/publication/306017711\\_FRUITS\\_BENEFITS\\_PROCESSING\\_PRESERVATION\\_AND\\_PINEAPPLE\\_RECIPES](https://www.researchgate.net/publication/306017711_FRUITS_BENEFITS_PROCESSING_PRESERVATION_AND_PINEAPPLE_RECIPES)
- Moyle, R. L., Crowe, M. L., Fairbairn, D. J. and Botella, J. R. 2005. Pineapple DB: An online pineapple bioinformatics resource. *BMC Plant Biology* 5 (1): 1-5.
- Nwachukwu, E. and Ezejiaku, F. C. 2014. Microbial and physicochemical characteristics of locally produced pineapple juice treated with garlic and ginger. *International Journal of Current Microbiology and Applied Sciences* 3 (6): 895-901.
- Rolle, R.S. 2006. Postharvest management of fruits and vegetables in the Asia-Pacific Region. Asian Productivity Organization and Food and Agriculture Organization of the United Nations ISBN: 92-833-7051-1, 36-47
- Sripaoraya, S., Merchant, R., Power, J. B. and Davey, M. R. 2003. Plant regeneration by somatic embryogenesis and organogenesis in commercial pineapple (*Ananas comosus*). *In Vitro Cellular and Developmental Biology-Plant* 39 (5): 450-454.