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Effectiveness of Guava (*Psidium guajava* L.) leaf extract on lipid oxidation and overall acceptance of dried Anchovy (*Stolephorus* sp.) fish during storage

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Guava leaf extract contained important active constituents such as essential oils, flavonoids, carotenoids, polyphenolic compounds, pentacyclotriterpenoids, esters, and aldehydes. Its extract was an excellent candidate as natural antimicrobial agent. Anchovy (*Stolephorus* sp.) was an important fish having good nutritional quality. It's rich in polyunsaturated fatty-acid therefore it's susceptible to lipid oxidation and rancidity, particularly after drying. Drying removed moisture accelerated the contact between fat and oxygen; highly promoted the lipid oxidation. Delaying lipid oxidation was very important to maintain the quality of dried anchovy product. In this research, guava leaf extract was incorporated into anchovy fish in different concentration (2.5-4.5%) for 60 minutes before drying and preserving at ambient temperature for 6 months. Biochemical indicators like peroxide value and free fatty acid were thoroughly examined. During preservation, the dried anchovy fish was also sampled to evaluate the overall acceptability. This research was conducted during 2020 at SocTrang Nanotech laboratory, SocTrang province, Vietnam. Our results revealed that guava leaf extract had greatly influence to retardation of lipid oxidation and rancidity as well as extending sensory score of the dried product during storage.

Keywords: Anchovy fish, guava leaf extract, incorporated, peroxide value, free fatty acid, overall acceptability

INTRODUCTION

Guava (*Psidium guajava* L.) is an evergreen small tree. The leaves of guava contain an essential oil rich in cineol, tannins, triterpenes, flavonoids, resin, eugenol, malic acid, fat, cellulose, chlorophyll, mineral salts, and a number of other fixed substances (Ncube et al. 2008). These bioactive constituents in the guava leaf are able to fight against pathogens, regulate blood glucose levels, and aid in weight loss (Bipulet al. 2013). Guava leaf extract can reduce level of insulin, accompany by exaggerated levels of blood glucose, lipid peroxidation product, and augment expressions of inflammatory cytokines (Muthukumaran et al. 2018). It's a phytotherapeutic plant to cure different ailments such as malaria,

gastroenteritis, vomiting, diarrhea, dysentery, wounds, ulcers, toothache, coughs, sore throat, inflamed gum, diabetes, hypertension, and obesity (Lutterodt, 1992; Morales et al. 1994; Jaiarj et al. 1999; Karawya et al. 1999; Abdelrahim et al. 2002; Begum et al. 2004; Sunagawa et al. 2004).

The sea areas of Vietnam and Thailand, count on about 80% of anchovy species in the world. In the middle of July is the season of anchovy fishery in the central provinces of Vietnam, from QuangNgai province to BinhThuan province. After catching, anchovies (*Stolephorus* sp.) were immediately washed and boiled in brine solution before spreading on the bamboo mat ready for drying (Doe, 2002). Drying of this fish resulted in extending shelf-life and improving desired flavours

and texture. Anchovy fish is rich in polyunsaturated fatty-acid. Therefore it is highly perishable owing to its biochemical reaction (Corbo et al. 2008). Fish spoilage occurred quickly after its death resulting in autolysis (Ordiales et al. 2016). Lipid oxidation is a major cause of quality deterioration in fish muscle as it produces bad flavor during processing, storage, handling and cooking (Ladikose and Lougovoise, 1990). One of alternatives to limit lipid oxidation, quality degradation is the incorporation of natural extracts instead of synthetic additives (Pereitti et al. 2012). These natural antioxidants are good source of phytochemicals, especially phenolics and flavonoids (Gorinstein et al. 2005). They have diversified role as functional and biochemical inhibitors of oxidative damage induced by free radicals. Objective of our study examined the influence of guava (*Psidium guajava* L.) leaf extract on lipid oxidation and organoleptic acceptance of dried anchovy (*Stolephorus sp.*) during 6 months of storage.

MATERIALS AND METHODS

Anchovy fishes were collected from KienGiang province, Vietnam. After collecting, they must be kept in styropore boxes and quickly conveyed to laboratory for experiments. Guava leaves were harvested in garden. Anchovy fishes were subjected to immersion with guava leaf extract before drying. This research was conducted during 2020 at SocTrang Nanotech laboratory, SocTrang province, Vietnam.

Researching method

1kg of guava leaves were finely cut and homogenized with 200 ml of ethanol 70% in blender for 3 minutes. The homogenate was filtered by cloth to receive extract. Anchovy fishes were immersed in guava extract in different concentrations (2.5-4.5%) together with a mixture of salt 5%, sugar 1.5%, garlic extract 0.5%, pepper 0.5%, monosodium glutamate 0.2% for 60 minutes before drying at 45°C for 18 hours by convective dryer. The dried anchovy fishes were kept in zipper bags at ambient condition for 6 months. The samples were monthly taken to analyse peroxide value (meq/kg), free fatty acid (%) and organoleptic acceptability.

Chemical and sensory analysis

Peroxide value (meq/kg) and free fatty acid (%) were determined by standard methods described by AOCS (1995). Organoleptic

acceptability was evaluated by a group of panelists using 9-point Hedonic scale.

Statistical analysis

The experiments were run in triplicate with three different lots of samples. The data were presented as mean± standard deviation. Statistical analysis was performed by the Statgraphics Centurion version XVI.

RESULTS AND DISCUSSION

Guava leaf extract exhibited antioxidant, hepatoprotection, anti-allergy, antimicrobial, anti-genotoxic, anti-plasmodial, cytotoxic, antispasmodic, cardioactive, anti-cough, anti-diabetic, anti-inflammatory and antinociceptive activities (Sherly et al. 2011). Drying eliminated the water activity, enhanced the contact between fat and oxygen; these might promote the lipid oxidation (Fu et al. 2012). Peroxide value evaluated the level of peroxides and hydroperoxides created in the beginning steps of lipid oxidation and it's popularly utilized for the evaluation of oxidative rancidity in fats and oils (Ólafsdóttir et al. 1997). Influence of guava leaf extract on the changes in the peroxide value of dried anchovy (*Stolephorus sp.*) during 6 months of storage was shown in table 1. Peroxide value of the dried anchovy was decreased gradually and in acceptable limit after 6 months of storage. Guava powder was found to retard lipid peroxidation of cooked sheep meat nuggets during refrigerated storage (Arun et al. 2013).

According to Nurul et al. (2017), the accumulation of free fatty acid in anchovies dried traditionally were recorded at 9.74±1.18 % oleic acid. Progressive oxidation and enzymatic hydrolysis of unsaturated fatty acids were the main cause of lipid deterioration in fatty fish which was accompanied by the emission of free fatty acids (Srikar and Hiremath, 1972). Free fatty acid values of the dried anchovy were elaborated in table 2. There was a significant decreased trend during storage. Guava leaf extract was recommended as natural preservation for mackerel fish (Riyanto, 2020).

Lipid oxidation had negative effects on the quality of fish resulting in changes in sensory property and nutritional quality. Oxidation of unsaturated lipids caused the formation of stale or rancid flavour (Sato and Hegarty, 1971). Apart from lipid, oxidative processes also led to the degradation of proteins contributing to the deterioration in flavour, texture and colour of products (Decker et al. 1995). Overall

acceptability of dried anchovy treated by guava extract during 6 months of storage was shown in table 3.

Table 1: Effect of guava leaf extract (%) on peroxide value (meq/kg) of dried anchovy during storage

Storage (month)	Guava leaf extract (%)				
	2.5	3.0	3.5	4.0	4.5
1	0.871±0.003 ^a	0.850±0.000 ^{ab}	0.821±0.001 ^b	0.807±0.002 ^{bc}	0.785±0.000 ^c
2	0.854±0.001 ^a	0.823±0.001 ^{ab}	0.803±0.000 ^b	0.763±0.002 ^{bc}	0.731±0.001 ^c
3	0.843±0.000 ^a	0.801±0.000 ^{ab}	0.780±0.002 ^b	0.716±0.001 ^{bc}	0.704±0.002 ^c
4	0.824±0.002 ^a	0.783±0.002 ^{ab}	0.757±0.000 ^b	0.675±0.001 ^{bc}	0.648±0.000 ^c
5	0.810±0.001 ^a	0.760±0.003 ^{ab}	0.721±0.001 ^b	0.623±0.000 ^{bc}	0.609±0.001 ^c
6	0.802±0.003 ^a	0.731±0.002 ^{ab}	0.702±0.003 ^b	0.597±0.002 ^{bc}	0.560±0.003 ^c

Figures are the mean of three replications; Figures in row followed by the same letter/s are not differed significantly ($\alpha = P=0.05$).

Table 2: Effect of guava leaf extract (%) on free fatty acid (%) of dried anchovy during storage

Storage (month)	Guava leaf extract (%)				
	2.5	3.0	3.5	4.0	4.5
1	2.31±0.01 ^a	2.08±0.00 ^{ab}	1.75±0.02 ^b	1.24±0.03 ^{bc}	1.02±0.01 ^c
2	2.07±0.03 ^a	1.73±0.02 ^{ab}	1.59±0.01 ^b	1.03±0.00 ^{bc}	0.76±0.02 ^c
3	1.75±0.00 ^a	1.29±0.01 ^{ab}	1.06±0.00 ^b	0.82±0.02 ^{bc}	0.50±0.00 ^c
4	1.30±0.02 ^a	1.02±0.00 ^{ab}	0.89±0.03 ^{ab}	0.63±0.01 ^b	0.44±0.02 ^c
5	0.96±0.01 ^a	0.83±0.03 ^{ab}	0.68±0.01 ^{ab}	0.40±0.00 ^b	0.39±0.03 ^b
6	0.54±0.00 ^a	0.38±0.02 ^{ab}	0.30±0.00 ^{ab}	0.29±0.02 ^{ab}	0.04±0.01 ^b

Figures are the mean of three replications; Figures in row followed by the same letter/s are not differed significantly ($\alpha = P=0.05$).

Table 3: Effect of guava leaf extract (%) on sensory acceptance of dried anchovy during storage

Storage (month)	Guava leaf extract (%)				
	2.5	3.0	3.5	4.0	4.5
1	6.19±0.02 ^c	6.85±0.00 ^{bc}	7.43±0.02 ^b	7.99±0.00 ^{ab}	8.34±0.02 ^a
2	6.02±0.01 ^c	6.57±0.02 ^{bc}	7.19±0.03 ^b	7.75±0.03 ^{ab}	8.11±0.00 ^a
3	5.83±0.02 ^c	6.13±0.03 ^{bc}	6.90±0.02 ^b	7.53±0.01 ^{ab}	8.00±0.00 ^a
4	5.41±0.03 ^c	5.89±0.01 ^{bc}	6.57±0.00 ^b	7.30±0.03 ^{ab}	7.86±0.03 ^a
5	5.07±0.00 ^c	5.51±0.02 ^{bc}	6.25±0.01 ^b	7.07±0.01 ^{ab}	7.62±0.01 ^a
6	4.78±0.01 ^c	5.34±0.00 ^{bc}	6.02±0.03 ^b	6.84±0.00 ^{ab}	7.43±0.02 ^a

Figures are the mean of three replications; Figures in row followed by the same letter/s are not differed significantly ($\alpha = P=0.05$).

Our results were similar to finding by Ordiales et al. (2016) in evaluating the impact of red onion and lemongrass extracts on lipid oxidation and acceptability of frozen deboned milkfish.

CONCLUSION

Guava leaf extract had a great attention in the fishery sector owing to its attractive characteristics such as health promoting bioactive constituents, functional elements. Incorporation of guava extract significantly affected the biochemical and sensory attributes of the dried anchovy fishes. It significantly protected the dried anchovy fishes from lipid oxidation and rancidity during preservation. Further studies on other fat fish with guava leaf extract should be recommended.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Nguyen Phuoc Minh arranged the experiments and also wrote the manuscript.

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