Effect of Using Unripe Jackfruit As A Meat Substitute On Nutrition Composition And Organoleptic Characteristic Of Meat Patty

Iman Abdullah
Politeknik Sultan Haji Ahmad Shah
iman121980@gmail.com

Abstract

The effect of using unripe jackfruit as a meat substitute in meat patty was studied on nutrition composition and organoleptic characteristic. Meat patties prepared by using different proportion of unripe jackfruit (25%, 50%, 75% and 100%). The meat patties were evaluated for nutrition composition and organoleptic characteristic. Statistical analysis from sensory evaluation test revealed no significant differences ($P < 0.05$) among formulations of the meat patties for taste and aroma characteristics. Nutrition composition of the meat patties were affected significantly with increasing levels of unripe jackfruit in meat patties. In general, the meat patties were accepted by the panelist during the sensory evaluation test and has potential as a new substitute to be used in meat products.

Keyword: jackfruit, meat patty, meat substitute

1. Introduction

The demand for convenience foods has increased drastically in recent years. Currently, fast food industry keep expanding and gain high demand from consumer in Malaysia. Fast food become preferences as it give quick meal solution due to busy and hectic life. Various type of fast food available provides wide-range of choices to Malaysian especially people in urban area. From the various type of fast food, burger is among the popular fast food consumed by Malaysian. According to FDA "Beef Patties" shall consist of chopped fresh and/or frozen beef with or without the addition of beef fat as such and/or seasonings. However, the vigorous extend of fast food consumption leads to health problem.

Presently, people become more health-conscious and concern about high fat diet. The demand of low fat product is increasingly. Due to this, meat products have become widely experimented as it contains high saturated fat and cholesterol. Over the past decades consumers have become increasingly concerned about the negative aspects of red meat consumption, which has mainly focused on the total and saturated fat contents. High animal fat content, saturated fatty acids and cholesterol of various meat products are associated with cardiovascular diseases, some types of cancer and obesity.

Development beef patty high in fibre and low in fat will help people have alternative way to choose healthier food. Thus the rate of obesity and heart disease can be control especially among children and adolescence. Jackfruit has been chosen as meat substituted in this

research. This fruit is a good source of carbohydrate as well as protein. The texture of unripe jackfruit pulp is smooth and tasteless which suitable to replace meat based product. Jackfruit will absorb the flavour added like spice or herbs to irritate the meaty flavour. When immature, it is amazingly similar in grain to chicken, making jackfruit is an excellent vegetarian substitute for meat. This new formulation to produce healthier meat patties will provide better option to consumer to choose healthier food and has high potential to be commercialized

2. Literature Review

2.1 Fast food effect on health

According to Goyal and Singh (2007), fast food is the world's fastest growing food type and it is quick, reasonably priced and readily available alternatives to home cooked food. However, the prevalence of obesity and diseases increasing as fast food consumption also increase. According to (Oh et al., 2005), high content of saturated fatty acid and cholesterol in beef burger could lead to cardiovascular diseases. Fat, trans Fatty Acids(TFAs) ,cholesterol and saturated fatty acid(SFA) of meat products have also been associated with obesity and cancers in developing countries(Slattery *et al.*,1999; Grundy,1994). Nutritional analysis shows fast food to be high in fat, saturated fat, energy density, fructose, and glycemic index, yet poor in fiber, vitamins A and C, and calcium. A typical fast food meal contains 1400 kcal, 85% of recommended daily fat intake, 73% of recommended saturated fat, but only 40% of recommended fiber and 30% of recommended calcium. Fast food's macronutrient composition, its large portion sizes, and its frequent pairing with equally large portions of sugar-sweetened soft drinks contribute to excessive energy intake.

2.2 Role of meat in the diet

Meat is a food which has been consumed by humans for thousands of years. As part of a balanced diet, meat is a good source of certain macro and micronutrients which are present in lower amounts in other parts of the diet. As an essential part of a mixed diet, meat ensures adequate delivery of essential micronutrients and amino acids and is involved in regulatory processes of energy metabolism (Biesalski, 2004).

2.3 Negative aspects of meat consumption

There has been a debate in recent years as to whether there is a link between red meat consumption and cancer, especially colorectal cancer (Baghurst, 2007). Certainly some compounds produced during red meat cooking are probable or possible carcinogens such as heterocyclic amines (HAs) and polyaromatic hydrocarbons (PAHs) (Alaejos et al., 2008; Baghurst, 2007). A link between mortality from the five most common cancers (lung, colorectal, prostate, stomach and breast) in the United Kingdom and meat consumption was investigated

by Key, Davey and Appleby (1999). There was no significant difference between meat eaters and vegetarians for any of the five cancers. However, Key et al. (1999) analysed results from five previous cohort studies and found that death rate ratios for ischemic heart disease in the age groups >65, 65-79 and 80-89 years were 45 % (P<0.001), 31% (P<0.001) and 8% (NS) lower for vegetarians than non vegetarians. Key et al. (1999a) found that vegetarians were 24% less likely to die from ischemic heart disease than meat eaters. Armstrong and Doll (1975) reported a strong link between meat consumption and the incidence of colorectal cancer and since then colorectal cancer has been widely suggested to be linked to red meat consumption. Since then, several epidemiological studies showed evidence that suggests a link but does not explain how meat contributes to colorectal cancer although there are several theories (Higgs, 2000).

2.4 Jackfruit

Jackfruit belongs to the genus Artocarpus which is one of the tropical fruit. Jackfruit is origin from South Western India. Jackfruit scientifically known as *Artocarpus heterophyllius*, locally known as "nangka" or "langka" is a favourite dessert of Filipinos (Goswami et al., 2011). Jackfruit is the largest edible fruit in the world (Naik, 1949 and Sturrock, 1959). It originated in the forests of the Western Ghats (India), where it still grows in the wild, as well as in the evergreen forests of Assam and Myanmar.

It is cultivated throughout Bangladesh, Burma, India, Indonesia, Malaysia, The Philippines, Sri Lanka, Thailand and to some extent in Brazil and Queensland (Australia). In Malaysia, Department of Agriculture Penang reported that jackfruit is widely planted in Johor, Pahang, Kedah and Terengganu. The unripe fruits are used in vegetable curries and pickles (Prakash et al. 2009). According to Bilton (2010), unripe jackfruit is savoury and eaten like a vegetable while ripe jackfruit is sweeter and often eaten fresh as a fruit.

Based on Self Nutrition Data, in 100 grams of raw jackfruit briefly contains 94 calories, 0.3 grams of total fat, 3 milligram of sodium, 24 grams of carbohydrate, 1.5 grams of protein and 2 grams of dietary fibre. Jackfruit has been reported to contain high levels of protein, starch, calcium, and thiamine (Brukill, 1997). The bulbs (excluding the seeds) are rich in sugar, fairly well in carotene and also contain vitamin C (Bhatia *et al.*, 1955). Jackfruit is also rich in nutrients such as sodium, potassium, iron, vitamin B, calcium, zinc, and many other nutrients. All parts of jackfruit have healing properties. Focusing on the fruit itself, it is one of the rare fruits that are rich in B-complex group of vitamins. It contains very good amounts of vitamin B-6 (pyridoxine), niacin, riboflavin, and folic acid.

The presence of high fiber content (3.6 g/100 g) in the jackfruit prevents constipation and produces smooth bowel movements. It also offers protection to the colon mucous membrane by removing carcinogenic chemicals from the large intestine (colon) (Siddappa 1957). Jackfruit is rich in magnesium (27 mg/100 g in young fruit and 54 mg/100 g in seed) (Gunasena and others 1996). It is a nutrient important in the absorption of calcium and works with calcium to help strengthen the bone and prevents bone-related disorders such as osteoporosis (Singh and others 1991). Jackfruit also contains iron (0.5 mg/100 g), which helps to prevent anemia and also helps in proper blood circulation (Singh and others 1991).The potassium in the jackfruit is found to help in lowering blood pressure and reversing the effects of sodium that causes a rise in blood pressure that affects the heart and blood vessels. This helps in preventing heart disease and strokes. Potassium also helps in preventing bone loss and improves muscle and nerve function. This fruit is also known to be beneficial to fighting asthma, ulcers, indigestion, tension, nervousness and constipation. It can slow down aging and cell degeneration.

3. Materials And Methods

3.1 Sample preparation and formulation of beef patties

Fresh meat and unripe jackfruit were obtained from local market. Imported lean meat grade B was chosen as the main ingredient. The meat patties prepared using formulation produce by Wan Rosli et al. (2006) with slight modification. Five experimental groups representing; commercial meat patty sample and samples with different percentages of unripe jackfruit. The percentages of others ingredients will not be changed, only the ratio between meat and pulp of unripe jackfruit differ. The control patties contain 100% meat. All of the ingredient were blended and homogenized with Robot Coupe R201 ultra E blender machine. Patties were made by adding 60g of the mixture into a burger patty former and pressing into shape. The patties were stored at -18°C.

3.2 Evaluation Of Meat Patties

3.2.1 Nutrient Composition of Beef Patties (Proximate analysis)

Proximate analysis was carried out in triplicate for each sample. The beef patties were analysed for moisture, crude protein, crude fat, crude fibre and total mineral matter and expressed in percentage according to the method described in AOAC.

3.2.2 Sensory Evaluation (Organoleptic Characteristics)

The sensory evaluation test were evaluated by 40 panelists from Food Technology Department. The beef patties were evaluated for texture, taste, juiciness and overall acceptability by using scoring method 5 point hedonic scale. A five-point scale represent 1=dislike very much; 2=dislike; 3=neither dislike nor like; 4=like and 5=like very much. Five samples of

patties were served to each participant. The participants were not informed about the content of the patties. The plain water was provided for subject to cleanse their palates between samples.

3.2.3 Statistical Analysis

The data collected on sensory evaluation and proximate analysis were statistically analysed using SPSS version 12. One-way analysis of varience (ANOVA) was used to analyze sensory evaluation result. Proximate analysis was also analyzed using one-way ANOVA. When a significant difference was detected, the means were further analyzed with post hoc test Duncan Multiple Range Test. Significance of difference were define as $P<0.05$.

4. Results And Discussion

4.1 Nutrition composition of meat patties

The data recorded in Table 4.1 pointed out that the moisture content was affected by different level of unripe jackfruit used. Control meat patties get the lowest value of moisture content, 68.01% whereas sample contained highest jackfruit level (75%) contain highest moisture content, 75.85%. All samples obtained significance difference value ($p<0.05$) of moisture content. It was clearly prove that as level of jackfruit increase, moisture content of meat patties also increase. Ash, represent mineral content in uncooked meat patties were proportionally increased with the increasing of jackfruit. Even so, ash content was not affected ($p>0.05$) with substitution of 25% and 50% unripe jackfruit. The presence of 75% of unripe jackfruit in meat patties increased ash content ($P<0.05$) as well as commercial patties.

Substitution with jackfruits significantly ($p < 0.05$) lowered the protein content of the patties. Data showed that meat patties formulated without jackfruit (control) significantly ($P<0.05$) recorded the highest protein concentration (21.68%) followed by meat patties with 25% and 50% unripe jackfruit (15.32% and 10.36%). The outcome was as expected since reducing meat content directly lowers the protein content. Meat patties formulated with any level of unripe jackfruit significantly ($p<0.05$) recorded lower content of fat compared to control and commercial sample. Sample with 75% contained 0.59% fat, followed by meat patties with 50% and 25% unripe jackfruit (1.26% and 1.75%). Commercial sample has higher fat content because the inclusion of fat as emulsifier. In an addition, different types and part of meat used also affected fat content. Since the type of meat used in the sample was lean meat, the fat content was relatively small.

From the result in the same table, it could be noticed that increasing jackfruit content significantly ($p<0.05$) increased crude fibre. Commercial sample get the lowest value of fibre content (0.41%), whereas the highest value of fibre (2.39%) contained in sample with 75% unripe jackfruit. Crude fibre does not represent total dietary fibre. According to

Azad et al. (2000), 100g of edible portion unripe jackfruit contain 2.6g to 3.6g of dietary fibre. Study done by Brown et al. (1999) investigate that soluble fibre reduces total and LDL cholesterol. One gram of soluble fibre can lower total cholesterol about 0.045 mmol/L. By incorporating these two ingredients, fibre from jackfruit could lower cholesterol obtain from meat.

The presence of unripe jackfruit in any level increased carbohydrate content ($p<0.05$) than control. The highest carbohydrate content was 12.62% and the lowest is 0.71%, in commercial sample. Potato starch, bread crumb and jackfruit contribute to the carbohydrate content. Concerning to calories content, data showed that as fat and protein content in meat patties decrease, total calories declined. Reduction rates in calories content of uncooked patties formulated with different levels of unripe jackfruit ranged from 115.73kcal to 82.13kcal. Sample with 75% unripe jackfruit contained lowest caloric value (82.13 kcal), whilst calories content was highest in commercial sample (269.72%), due to high content of fat. Calories value in cooked beef patties were increased in all sample. Caloric reduction positively correlated with fat reduction (El-Beltagy *et al.*, 2007; Mansour, 2003; Khalil, 2000). These results indicated that formulation patties with unripe jackfruit considered as a good method for caloric reduction which is very important for consumers restricted for their fat intake.

Table 4.1: Nutrient composition in raw beef patties incorporated with unripe jackfruit*

Nutrient composition (%)	**Sample A (0% JF)**	**Sample B (25% JF)**	**Sample C (50% JF)**	**Sample D (75% JF)**	**Sample E (commercial)**
Moisture content	$68.01^{b} \pm 0.39$	$70.15^{c} \pm 0.56$	$73.61^{d} \pm 0.59$	$75.85^{e} \pm 0.36$	$58.36^{a} \pm 0.95$
Ash/mineral matter	$1.83^{a} \pm 0.05$	$1.88^{ab} \pm 0.03$	$1.92^{ab} \pm 0.11$	$2.09^{c} \pm 0.13$	$2.03^{bc} \pm 0.13$
Protein	$21.68^{d} \pm 0.71$	$15.62^{c} \pm 0.74$	$10.36^{b} \pm 0.39$	$6.731^{a} \pm 0.68$	$14.57^{c} \pm 0.87$
Fat	$2.56^{d} \pm 0.11$	$1.75^{c} \pm 0.15$	$1.26^{b} \pm 0.09$	$0.59^{a} \pm 0.10$	$23.92^{c} \pm 0.51$
Crude fibre	$0.57^{a} \pm 0.74$	$1.22^{b} \pm 0.12$	$1.82^{c} \pm 0.16$	$2.39^{d} \pm 0.14$	$0.411^{a} \pm 0.04$
Carbohydrate	$5.42^{b} \pm 0.36$	$9.37^{c} \pm 0.21$	$11.05^{d} \pm 0.85$	$12.62^{e} \pm 0.15$	$0.71^{a} \pm 0.46$
Energy	$131.45^{d} \pm 0.97$	$115.73^{c} \pm 1.62$	$98.21^{b} \pm 2.44$	$82.13^{a} \pm 1.89$	$269.72^{e} \pm 8.25$

*means of three determinations ± standard deviation
*means in the same column with different letters are significantly difference ($p<0.05$)

4.2 Sensory evaluation result (Organoleptic Characteristics)

Taste characteristic were not affected by substitution of unripe jackfruit. This was proven by analysis show in table 4.2 that there are no significance differences ($p>0.05$) among all patties. Consumer can accept the taste of substituted meat patties, similar with the acceptance of 100%

meat, and important point here there is no significance difference with commercial one. Sample B (25% jackfruit) get the highest score for taste (3.98) followed by sample C , E, A and sample D, get the lowest score (3.00). this positive result indicate that meat patties substitute with jackfruit can be commercialize in current market.

Data show that meat patties formulated with levels of 50% and 75% of unripe jackfruit as meat replacer were significantly higher ($p<0.05$) in tenderness than the control samples. Sample contained 25% and 50% unripe jackfruit get the highest score (3.98) and lowest score obtained by control sample (3.05).The entire sample except at the 25% of unripe jackfruit was significantly difference ($p<0.05$). Throughout this result, assumption can be made that jackfruit existence only affect the texture if it is in large amount. Control sample also has significance difference with commercial meat patty. This is may be due to different part of meat has been using for this study. Normally commercial meat patty will use deboned meat whereas in this study 100% meats were use.

Control samples had significantly the lowest value of juiciness (3.08), whereas patties formulated 75% of unripe jackfruit had higher rating (3.93). However, there is no significance difference between control and sample contained 25% unripe jackfruit, similar result when compare with commercial patties. Hypothetically juiciness level is influence by moisture content. Higher moisture content contributes to high level of juiciness. These findings are consistent with those of Pinero et al. (2008) who found that meat patties containing oat's fibre were found to be significantly ($P>0.05$) juicier than the control, which a could be attributed to the increased moisture retention of the product during cooking. Juiciness was rated highest for 10% tempeh while the control was rated significantly ($p < 0.05$)lower and 10% breadcrumb did not differ significantly ($p > 0.05$) from either treatment. Increases in juiciness with 10% substitution of carbohydrate-lipid composites or 10% tomato paste have also been reported (Garzon et al., 2003; Candogan, 2002).

There are no significance differences among all patties in term of aroma. It shows that the presence of jackfruit does not influence aroma or odour of meat patties. Control sample (100% beef) get the highest value (3.88) while the 75% unripe jackfruit contain in sample D get the lowest value (2.90). Control sample able to maintain the beef aroma as it contain is 100% beef. Even though the value was not significance difference, the decreasing pattern can be observed while unripe jackfruit contains increases in each sample. By substituting unripe jackfruit, it reduces the intensity of meat odour, but only in small effect.

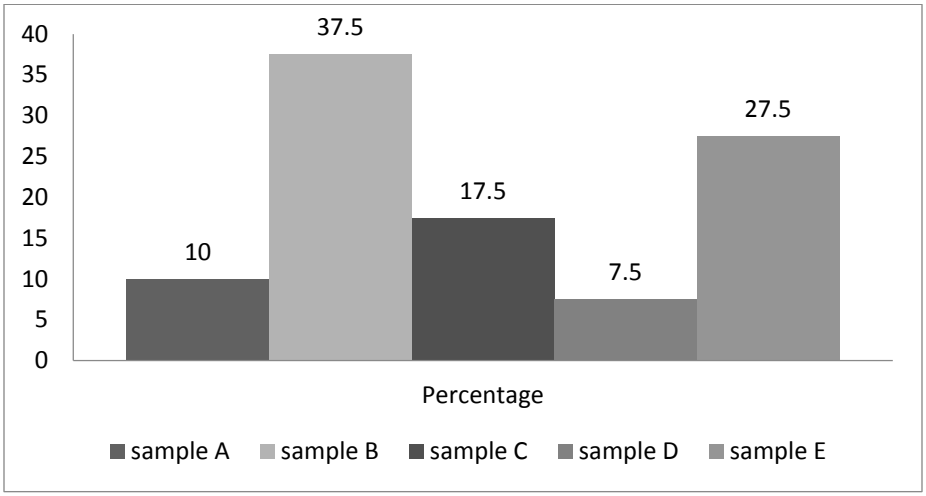
Table 4.2: Sensory Attributes of Cooked Beef Patties Formulated With Differences Levels of Unripe Jackfruit

Traits	Sample A (0%JF) (Control) Mean±SD	Mean±SD		p- value
Taste	3.40±1.033	Sample B (25% JF)	3.98±0.891	0.511
		Sample C (50%JF)	3.75±0.899	0.509
		Sample D (75%JF)	3.00±1.013	0.071
		Sample E (Commercial)	3.75±0.840	0.848
Texture	3.05±1.061	Sample B (25% JF)	3.98±0.800	1.000
		Sample C (50%JF)	3.98±0.768	0.001
		Sample D (75%JF)	3.28±1.012	0.001
		Sample E (Commercial)	3.70±0.823	0.047
Juiciness	3.08±1.047	Sample B (25% JF)	3.50±0.966	0.710
		Sample C (50%JF)	3.88±0.829	0.001
		Sample D (75%JF)	3.93±0.987	0.003
		Sample E (Commercial)	3.38±1.005	1.000
Aroma Intensity	3.88±0.911	Sample B (25% JF)	3.80±0.883	0.153

Sample C (50%JF)	3.33±0.971	0.164
Sample D (75%JF)	2.90±0.871	0.052
Sample E (Commercial)	3.72±0.933	0.583

* p<0.05
* SD=standard deviation
*JF=unripe jackfruit

4.3 Preference percentages of meat patties



n=40

Figure 4.3: Preference percentage of meat patties

Figure 4.3 shows percentage of most preference samples. Based on the outcome, sample B represent 25% of substitution unripe jackfruit are the most prefer meat patties, follow by commercial sample, 50%substituted jackfruit, 100% meat and 75% meat patties contain jackfruit get the lowest score. Sample B were chosen as it still maintain the sensory quality of meat patties. By substituting only 25% unripe jackfruit, it still retain the meaty flavour .In an addition, it is juicier, and more tender that control. Plus, no weird aroma was detected in this sample. This result is parallel with overall acceptance trait as sample 25% unripe jackfruits get the highest score.

5. Conclusion

The research demonstrated that unripe jackfruit can be successfully incorporated into beef patties to create a product with market potential. Substitution of unripe jackfruit resulted in decreasing fat content, whilst increasing in fibre. Beef patties with added unripe jackfruit showed the highest moisture and fibre content. Quality of substituted beef patties with unripe jackfruit will not achieve desirable outcome if it was not hold with suitable meat extenders, meat binders and spices. In term of sensory quality, consumers were not able to differentiate taste and overall attributes between burgers containing different level of unripe jackfruit and control. In summary, the addition of substituition resulted in an increase in the nutritional composition, while maintaining the sensory quality of meat patties, so they are as acceptable to consumers as normal meat patties. This incorporation could permit a reduction of the formulation cost without affecting sensory descriptors of the product to which the consumer is familiarized.

Referrences

Aminah, A. (2004). Prinsip Penilaian Sensori. Edisi. Ke-2. Bangi: Universiti Kebangsaan Malaysia.

AOAC. Official Methods of Analysis of Association of Official Analytical Chemists. Washington, D.C; 2000.

Azad, A.K. (2000). Genetic diversity of jackfruit in Bangladesh and development of propagation methods. Ph. D Thesis, University of Southampton, UK. 200 p.

Biesalski, H.K. (2005). Meat as a component of a healthy diet - are there any risks or benefits if meat is avoided in the diet?. *Meat Science*, 70 (3), 509-524.

Candogan, K. (2002). The effect of tomato paste on some quality characteristics of beef patties during refrigerated storage. *European Food Research and Technology*, 215(4), 305-309.

Mansour, E.H. & Khalil, A.H. (1999). Characteristics of low fat beef burgers as influenced by various types of wheat fibres. *Journal of the Science of Food and Agriculture*, 79(4), 493-498

Muchenje, V., Dzama, K., Chimonyo, M., Strydom, P.E., Hugo, A. & Raats, J.G. (2009). Some biochemical aspects pertaining to beef

eating quality and consumer health: A Review. *Food Chemistry*, 112(2), 279-289.

Pinero, M. P., Parra, K., Huerta-Leidenz, N., de Moreno, L. A., Ferrer, M., Araujo, S. and Barboza, Y. (2008). Effect of oat's soluble fibre (b-glucan) as a fat replacer on physical, chemical, microbiological and sensory properties of low-fat beef patties. *Meat Science* 80: 675-680

Rahman M.A, Nahar N, Mian A.J, Moshiuzzaman, M. (1999). Variation of carbohydrate compostion of two forms of fruit from jack tree (Artocarpus heterophyllus L) with maturity and climatic condition. *Food Chemistry* 65:91–7.

Rehab, F.M. Ali, A.M. El-Anany and A.M. Gaafar, (2011). Effect of potato flakes as fat replacer on the quality attributes of low-fat beef patties. *Advance Journal of Food Science and Technology*. 3 (3), pp.173-180