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EFFECTIVENESS OF SOME FORTIFIED NUTRITIONAL PRODUCTS WITH SUN DRIED BANANA PEELS ON MOODY STATUS OF FACULTY EDUCATION STUDENTS IN NUJRAN

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ABSTRACT: *Banana Peels are important in protection from chronic diseases as blood pressure, anemia and depression; it contains vitamins C, E, B6, minerals and phenols which act as antioxidants. Objective: This study was performed to know effectiveness of some fortified nutritional products with dried banana peels on moody status of faculty of education students. Methods: Sample of (30) students are selected to perform difficult test, and they became anxiety, tension and depressed. The students ate fortified products with 20% banana peels (Cake, Biscuit, and Cookies). After half hour, a questionnaire of status mood evaluation is used to evaluate the mood status of the students. The results revealed that the mood status is improved, the sensory evaluation of fortified products is better than control samples. Chemical analysis of dried banana peels protein, fat, carbohydrate, crude fiber were respectively (7.21±0.34, 4.78±0.91, 86. 7±0.25, 43.38±0.05, 1.31±1.07, 6.67±1.08), vitamins (A, B1, B6, C, E), were (9.074±1.4, 0.65±0.13, 1.85±0.5, 1.38±0.17, 129.78±6.8, 0.26±0.11), minerals potassium, calcium, sodium, iron, magnesium, phosphor were (63.51±0.17, 15.66±0.38, 21.45±0.24, 0.17 ±0.11, 67.87±0.41 and 41.08±1.7).Total antioxidants and phenolic were (91.05±1.69, 65.36±1.53). Finally, this study recommended using dried banana peels in bakery products to improve mood status. Because it is rich in minerals, antioxidants, phenolic and tryptophan which converted to serotonin, make anyone relax and happy.*

KEYWORDS: Bananas, Banana Peels, Depression, Mood

INTRODUCTION

Mood status is playing important role in human life where the bad mood is classified as depression, which is a public health problem, it appears in the ages (20-50) years (WHO, 2010), may be because of genetics, biochemical, environmental and psychological factors (NIMH, 2008 and MPA, 2006). Types of depression are mild, medium and severe depression (NIMH, 2008). Depression can be treated with antidepressants, but it has side effects as nervousness, blurred vision and suicidal thoughts (Department of Health and Ageing, 2003 and NIMH, 2008).The characteristics of depression are bad mood, loss of interest and appetite. Some people used herbal therapy or fruits especially bananas or banana peels as antidepressant (Tan Pei Tee and Halijah Hassan, 2011). Also vegetables are considered one of the important parts against depression because of the contents of antioxidants and antimicrobial represented in vitamin C, E or ß-carotene. Some fruits have medical properties like banana fruit (BF). It is the important popular fruits in the world because it grows in tropical regions in over (122) countries and African countries, and considered a good source of minerals (P, Ca, Mg, Mn, and Fe) and antioxidant as gallocatechin and dopamine, bananas have functional properties against cancer and heart disease because it contains vitamin C, E, and ß carotene (Mokbel and Hashinaga, 2004 , Marisa Wall, 2006 , Husain and William, 2010 , Someya et al., 2002 , Subbaiah et al,

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2013 and Sarawong et al, 2014) . Also it treats blood pressure because it contains potassium (Debabandya *et al*, 2010 &Amarnath and Balakrishnan, 2007). (Rafaela Gonzalez Montelongo et al, 2010) extracted antioxidants from bananas and BP, and showed that the antioxidants in the peels more than the pulp.

(Rodriguez Ambriz et al, 2008) mentioned that banana flour is high level of indigestible polysaccharides, dietary fiber, vitamins, minerals and antioxidants. It could be used in some bakery products as bread to improve the nutritional quality and value to reduce the waste (uárez García et al, 2006 & Garzón et al., 2011). (Perla Osorio Díaz1 et al, 2014) used banana flour blends for spaghetti formulation. The waste extracted from the fruits is too large and caused environmental problems, so it can be disposed as subsidized (Zhang et al, 2005). For example BP consists of 30%- 40% of total weight of the fresh fruit (Chen et al, 2007 and Anhwange et al, 2009), also (Ghorade et al, 2011 and Fatemeh et al, 2012) mentioned that BP represents 47-50%, it could be used in animal feed or fertilizer. All parts of bananas plant including the peel have clinical properties for cardiovascular health, strokes, ulcers, wounds, burns, improvement blood pressure, the mood status, constipation, diarrhea, arthritis and anemia because it rich in iron (Sampath Kumar et al, 2012& Amit and Shailandra, 2006 & Debabandya et al, 2010 & Brooks, 2008 and Ponnuswamy et al, 2011& Sampath Kumar et al, 2012 & Amit and Shailandra, 2006 & Girish and Satish, 2008). In addition to the antibiotic, it acts against mycobacteria, antimicrobial activities, Antifungal and antibiotic principles (Omojasola and Jilani, 2009 & Brooks, 2008 & Ponnuswamy et al, 2011). Also dietary fiber and pectins (50% on a dry matter) from (BF) and BP, proteins (7% dry weight), amino acids, polyunsaturated fatty acids and potassium can be extracted (Emaga et al, 2007 and Thomas Happi Emaga et al, 2008). BP contains potassium, calcium, phosphorus, sodium, iron, manganese, bromine, rubium, strontium, zirconium, niobium and some organic compounds (Chen et al, 2007 and Hettiaratchi, 2011) also If BP exploited well, it will be a good source of carbohydrates and minerals (Anhwange, 2008). It is possible to use BP in several industrial applications as bio-fuel production, bio-sorbents, pulp and paper, cosmetics, energy related activities, organic fertilizer, environmental cleanup, finally nutritional application like bread from wheat, defatted soy and banana flours (Bori et al, 2007 and Igbabul Bibiana Dooshima, 2014).

Fresh and dried banana peels may be modify acute liver failure because it contains vitamins and minerals that can act as antioxidant, in addition to phenols. Previous studies have approved the existence of vitamin C, E, D, B6 and B12 in banana peels, especially vitamin C that acts as antioxidant (Zenab Mosa and Ayman Khalil, 2015 & Mokbel et al, 2005). the ripe banana pulp and peel contain phytochemicals (anthocyanin, delphinine, cyaniding; Seymour, and catecholamines) (Sun, 2002). (Ehiowemwenguan, et al, 2014) they showed that BP is rich in carbohydrate and phytochemicals. Phenolics in BP ranged 0.90 to 3.0 gram/100 g DW (Nguyen et al, 2003), study of (Kondo et al, 2005 and Sulaiman et al, 2011) demonstrated that BP includes higher phenolic compounds more than banana pulps. According to (Someya et al, 2002) explained that total phenolic in the peel 907 mg/100 g DW than in pulp 232 mg/100 g DW it is inhibits gastric secretion and stimulates the smooth muscle of the intestines and make relax and happy, also (Velumani, 2016) studied Phytochemical and antioxidant in BP, he mentioned that if peels exploit will be a good source of antioxidant, phytochemicals and phenolic, also some studies recommended using BF or BP to improve mood and antidepressant (Tan Pei Tee and Halijah Hassan, 2011), because BP is contain tryptophan which converted into serotonin, it is inhibits gastric secretion and stimulates the smooth muscle of the intestines and make relax and happy , So BP can be used as clinical nutrition(Ratule et al, 2007, Jahan, 2010, Girish &Satish, 2008 and Anhwange et al, 2009).According to (Tavakkoli Kakhki et al.,

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2014 & Kumar et al, 2012) they recommended that bananas for depressed patients. Biscuits and cakes are considered of the popular bakery consumed all over the world (Aggarwal, et al, 2016), so this study aimed to study effectiveness of some fortified food products with dried bananas peels on moody status and depression.

MATERIALS AND METHODS

Materials:

Source of samples:

- Banana peels used in the study were obtained from bananas fruit, purchased from local market, Cairo, Egypt, EL Fayoum, February 2017.
- Wheat flour extraction (70-72%) was obtained from local market, Cairo, Egypt, EL Fayoum.
- white sugar, salt, butter, eggs, bananas were obtained from local markets, Cairo, Egypt, EL Fayoum.
- Thirty students from faculty of education, Nujran University, are selected to evaluate the supplemented products and measure the mood status.
- Sensory evaluation form, included (Taste, Crust Color and Pulp Color, flavor, pores, texture and overall acceptability).

Preparation of raw materials

Banana peels powder:

- The peels were obtained from banana fruit, washed well, peels were removed and washed well by water, the peels were dried by air for two weeks, grind to soft powder, sieved with a mesh of size 0.50mm and the particle size of less than 1.0 mm (Adejuyitan et al., 2008). Powder peels stored in plastic bags at freezer until needed for using.

Preparation of supplemented products with banana peels

- Three types of food products (Cake, Biscuit and cookies) were supplemented with dried banana peels (DBP) at level (20%).
- Formulas consisted of 80 and 100 gm of flour, 25 gm sugar, one egg and 25 gm butter, half cup milk, as mentioned in Table (1).
- Replaced 20% wheat flour (WF) with 20% DBP.
- Flour and other ingredients were mixed and the dough at room temperature for 15 min, it was leaved 10 minutes , formed, and baked at 200^{o} C for 10 minutes in an electric oven.

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Sensory evaluation of supplemented (Cake, Biscuit and cookies):

- Thirty students are selected to evaluate (Taste, Crust Color, and Pulp Color, flavor, pores, texture and overall acceptability) of supplemented samples of (Cake, Biscuit and cookies) compared to control.
- The samples obtained degree (4:5) were acceptable.

Samples of students:

- Thirty Students were selected to perform difficult test, they got low scores and, a questionnaire of mood status evaluation was used to evaluate the mood status of them, they became, anxiety, tension, lack of concentration and depressed. They ate fortified products with (20%) DBP (Cake, Biscuit, and Cookies).After half hour, a questionnaire of mood status evaluation was used to evaluate the mood status of them and evaluation supplemented products with (20%) BP (Taste, Crust Color, Pulp Color, flavor, pores, texture and overall acceptability,) compared to control.

Analysis:

Chemical analysis of banana peels:

- Protein content, fat, crude ash, crude fiber content were determined according to A.O.A.C(Association of Official Agricultural Chemists, 2007) and total carbohydrates were calculated by difference : total carbohydrates= 100 – (g protein + g fat + g ash).

Determination of vitamins

- The content of vitamins (A , B1, B2, B6, E and C) were determined by methods described by (J. of chromatography B 816 : 67-72 , 2002nand Sanchez Machado et al, 2006). These analyzes were determined by Food Technology Research Institute, Cairo University.

Determination of minerals

- Minerals content (K, Ca, Na, Mg, Fe and p) were determined according to the methods of the (A.O.A.C, 2005) by FTRI, Cairo University.

Determination of antioxidants and phenolic compounds

- The content of antioxidants and phenolic were determined according to (Su and Silva, 2006). These analyzes were determined by FTRI, Cairo University

Statistical analysis:

Statistical analysis of results was statistically analyzed using computer program (SPSS, 2010). One way analysis of variance (ANOVA), low significant differences (LSD) and the difference was considered significant at p value <0.05 according to (Zar, 1984**).**

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RESULTS AND DISCUSSIONS

Table (1): Formulas of (Cake, biscuit and cookies) at level (20%) of DBP (g/100 g).

Samples / Matters	Cake		Biscuit		Cookies	
	Formula 1 (0)	Formula 2 (20%)	Formula 1 (0)	Formula 2 (20%)	Formula 1 (0)	Formula 2 (20%)
WF gm	100	80	100	80	100	80
BP gm	0	20	0	20	0	20
Butter gm	25	25	25	25	25	25
Sugar gm	25	25	25	25	25	25
Salt gm	5	5	5	5	5	5
Milk ml	50	50	0	0	0	0
Eggs	1	1	1	1	1	1
Vanilla gm	5	5	5	5	5	5
Baking powder gm	7	7	7	7	7	7

* Formula 1: WF 100% (B0) control, Formula 2: BP 20% (B1).

Sensory properties, included taste, color of pulp, color of crust, flavor, texture and Overall acceptability of supplemented samples (Cake, Biscuit and cookies) with (20%) BP by replacing (20%) WF (70-72% extraction) presented in Table (2). The replacement of (20%) BP hadn't different significant, but it improved sensory properties, the results of mean values were (4.9, 4.7, 4.7) respectively compared to control (4.8, 4.8, 4.9). These results go parallel with (Igbabul Bibiana Dooshima et al, 2014) whose studied quality evaluation of composite bread produced from wheat, defatted soy and banana flours, it showed that bread from the composite flours of 20% substitution for both defatted soy and banana flours were accepted. According to the study of (Nareman Eshak, 2016) about sensory evaluation and nutritional value of balady flat bread supplemented with banana peels as a natural source of dietary, she showed that replacing bread at 10% BP was accepted as sensory evaluation and nutritional value.

Table (2): Mean values of sensory evaluation of supplemented products with DBP and control sample.

Samples / Sensor evaluation	Samples					
	Cake		Biscuit		Cookies	
	Control	Fortified cake With 20%	Control	Fortified Biscuit With 20%	Control	Fortified Cookies With 20%
Taste	4.5	5.00	4.5	5.00	5.00	5.00
Color of crust	5.00	4.5	5	4.5	5.00	5.00
Color of pulp	5.00	5.00	4.5	5.00	5.00	4.5
Flavor	4.5	5.00	5	4.5	5.00	5.00
Texture	5.00	5.00	5	4.5	4.5	5.00
Overall acceptability	24.00	24.5	24.00	23.5	24.5	24.5
Mean	4.8	4.9	4.8	4.7	4.9	4.7

* N = (30); the samples were obtained to (4-5 point) are acceptable.

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Banana peels contain various and important nutrients as minerals (potassium, calcium, sodium, iron and magnesium), vitamins (A, B1, B2, B6, E and C), tryptophan and rare compounds (antioxidants and phenolics). Data presented in Table (3) showed the proximate composition of BP compared to BF and WF (70-72% extraction). It cleared low in the protein content in BF and BP (1.07±0.18 and 7.21±0.34) respectively compared to WF (11.3±0.2). Fats content in BP was high (4.78±0.91) more than BF and WF (0.35±0.3 and 2.16±0.3). Fats have a vital role and biological functions in cells, it is used as energy source. The carbohydrates content of WF was low (85.84±0.4) compared to BF and BP (95.44±2.1 and 86.7±0.25) respectively, these results agreed with (Anhwange, 2008), he mentioned that If BP exploited well, it will be good source of carbohydrates and minerals. The crude fiber content of BF and BP was high (2.57±0.6 and 43.38±0.05) in contrast the content of fiber in WF was (0.43±0.1) also the ash content of BF and BP was (3.14±1.96 and 1.31±1.07) respectively, it was very high compared to WF (0.7±0.11), ash is an indication to minerals in the sample. Unlike the moisture, it was low (6.67±1.08) in BP compared to BF and WF (67.45±1.2 and 13.3±0.2). These results went parallel with those of (Zenab and Ayman, 2015) in the analysis of (proteins, fats, carbohydrates, fiber, ash and moisture) and study (Gomes et al,2016) based on evaluation the physical, chemical and microbiological characteristics of supplemented bread with green BF with its peels.

Table (3): Chemical analysis of WF, BF and BP (g / 100 gm.).

Parameters	WF gm./100gm (70-72% extraction)	BF gm. /100gm	BP gm. /100gm
Crude protein	11.3±0.2	1.07±0.18	7.21±0.34
Crude Fat	2.16±0.3	0.35±0.3	4.78±0.91
Carbohydrate	85.84±0.4	95.44±2.1	86.7±0.25
Crude fiber	0.43±0.1	2.57±0.6	43.38±0.05
Total ash	0.7±0.11	3.14±1.96	1.31±1.07
Moisture content	13.3±0.2	67.45±1.2	6.67±1.08

*The data presented as mean ±SD. of three independent analyses.

*TC = Total carbohydrate was calculated by difference.

Table (4). Showed the content of vitamins of BP compared to BF. The mean values of vitamins (B1, B6 and C) were high in BP (0.65±0.13, 1.38±0.17 and 129.78±5.7) respectively compared to BF (0.079±.03, 0.362±0.04and 9.1±0.6), but it was observed increasing in the content of vitamin (A and C) in BF (93.65±0.8 and 0.317 ± 0.1) more than BP (9.074±1.4 and 0.26±0.11). (Adlin, 2008) demonstrated that BP contains vitamins C, E, and B6. Vitamin C acts as antioxidant and serotonin acts as antidepressant.

Table (4): Chemical analysis of vitamins in BP compared with BF.

Vitamins	BF	BP
Vit. A (µg/100g)	93.65±0.8	9.074±1.4
Vit. B1 mg/g	0.079±.03 mg	0.65±0.13
Vit. B6 mg/g	0.362±0.04	1.38±0.17
Vit. C (PPm)	9.1±0.6	129.78±5.7
Vit. E mg/g	0.317 ± 0.1	0.26±0.11

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Data presented in (Table 5) explained minerals content in BP. The amount of calcium, sodium, magnesium, and phosphorus in BP were high (15.66±0.38, 21.45±0.24, 67.87±0.41and 123.2±0.53) respectively compared to BF (5.23± 0.74, 1.03± 0.01, 26.51± 2.8 and 23±1.4), conversely potassium content and iron in BP were low (63.51±0.17 and 0.17± 0.11**)** compared to BF (356±5.11 and 0.27± 0.27) respectively. These results agreed with the results of (Zenab and Ayman, 2015).They reported that minerals content (K, Ca, Na, Fe, Mg and P) in BP were (62.81±0.14, 16.75±0.14, 22.34±0.34, 0.15 ±0.12, 65.14±0.37 and 41.08±1.7) respectively. According to study of (Nareman S. Eshak, 2016) about minerals content in BP, she reported that it is high in potassium, calcium, sodium, iron and manganese compared with WF. Also (Benjamin Anhwange and Joseph Torshian Ugye, 2009) studied the chemical composition of BP of minerals (Ca, Na, P, Mg, K, and Fe). Study of (Adlin, 2008) about the content of minerals in BP. He reported that BP consist of (55.59%) calcium, (0.36%) Phosphor and gross energy (3727 kcal/kg).

Table (5): Minerals content in BP (mg/100g) compared to BF.

Minerals	BF(mg/100g)	BP (mg/100g)
Potassium	356±5.11	63.51±0.17
Calcium	5.23± 0.74	15.66±0.38
Sodium	1.03± 0.01	21.45±0.24
Iron	0.27± 0.27	0.17± 0.11
Magnesium	26.51± 2.8	67.87±0.41
phosphorus	23±1.4	41.08±1.7

Table (6) Illustrated chemical analysis of total antioxidant and total phenolic compounds in BP compared to BF. The results showed that antioxidants and phenolic in BP (91.05±1.69 and 65.36±1.53) respectively compared to BF (37.98±2.89 43.96±0.3), this showed increasing in the content of antioxidants and phenolic in BP more than BF, so BP is considered a good source of antioxidants and phenolics. Also BF is considered of commonly fruit that consumed in the most part of world. The values of total phenolic compounds were (44.46±5.64 and 52.02 ± 4.22/ 100 g) respectively (Mèlo etal, 2006). Also Banana pulp contains various antioxidants, vitamins, carotenoids, and phenolic compounds as catechin, epicatechin, lignin and tannins, and Anthocyanins (Someya et al., 2002).This results are lined with (Ehiowemwenguan, et al., 2014) whose mentioned that BP are contained Phytochemical include: glycosides, alkaloids, saponin, tannins, flavonoids and volatile oil. According to (Aline Pereira n and Marcelo Maraschin, 2015), they mentioned that banana's pulp and peels can be used as natural sources of antioxidants and pro-vitamin A due to their contents in carotenoids and phenolic due to their contents in carotenoids ,phenolics , and amine compounds and it could be riche in beneficial bioactive compounds.

Table (6): Chemical analysis of total antioxidants and total phenolic compounds in BP compared with banana fruit.

Parameters	BF mg/100gm	BP mg/100gm
Total antioxidants	37.98±2.89	91.05±1.69
Total phenolic	43.96±0.3	65.36±1.53

*Test results of antioxidants of antioxidant activity by DPPH radical %

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CONCLUSION

Mood status is very important for human, so we should be care about eating healthy foods as vegetables and fruits, especially banana fruit, it isn't only rich in carbohydrates, antioxidants, but it is a good source in minerals (potassium and iron), also scientific studies have shown that bananas have a vital role in improving the mood and treatment depression, because it contains vitamins, minerals, antioxidants and tryptophan which improve the mood, also banana peels have the same properties. It is rich in minerals such as (K, P, Ca, Fe and Mg), vitamins (A, B complex, E and C) and tryptophan which converts into serotonin, make you relax, and happy. So fruit peels as banana peels could be used as supplementing of some bakery products as cake or biscuit with chocolate and cookies as clinical nutrition to improve mood and treatment depression, in addition, its uses for diabetics patients, high cholesterol, ulcers, wounds, burns of body, constipation, diarrhea, arthritis and anemia. So the objective of this research effectiveness of some fortified nutritional products with dried banana peels on moody status. From the previous results, the sensory evaluation of supplemented food (Cake, Biscuit and Cookies) with dried banana peels was accepted and it is useful for improving the mood and depression.

Recommendation:

- Raising of nutritional awareness of people for consumption bananas especially in the case of depression.
- Educate people about the health benefits of banana peels for depression.
- It is recommended to use banana peels in bakery products to improve the mood and depression.

Figure (1): Control cake and fortified with (20%) BP.

Control cake **Fortified Cake with 20%**

Figure (2): Control biscuit and fortified with (20%) BP.

Control Biscuit **Fortified biscuit with 20%**

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Figure (3): Sample of control cookies and fortified with (20%) BP.

Control Cookies **Fortified Cookies with 20%**

Abbreviation

Abbreviation	Mean
N	Number of sample.
TC	Total Carbohydrates.
DPPH	Organic chemical compound 2,2-diphenyl-1-picrylhydrazy.
DW	Dry weight.
g or gm	Gram.
AOAC	Association of Official Agricultural Chemists.
SPSS	Statistical Package for the Social Sciences.
ANOVA	Analysis of variance.
SD	Stander division.
BF	Banana fruit.
BP	Banana peels.
LSD	Low significant differences.
WF	Wheat flour.
DBP	Dried banana peels.
C	Celsius
FTRI	Food Technology Research Institute

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REFERENCES

A.O.A.C, (1975). Method of Analysis, 12th ed. The Association of Official Analytical Chemists, Washington, DC.

A.O.A.C, (2005). In: Official Methods of Analysis, vol. 8. Association of Official Analytical Chemists, Arlington, Virginia, D.C., USA, pp. 242–273.

A.O.AC, (2007). Official methods of analysis of AOAC international. 18th ed. Washington: Association of Official Analytical Chemists.

Adejuyitan, J.A., Adelakun, O.E., Olaniyan, S.A., Popoola, F.I, (2008).Evaluating the quality characteristics of kunun produced from drymilled sorghum. Afr. J. Biotechnology. 7 (13), 2244–2247.

Adlin, N.M.D.Y, (2008). Correlation between total phenolics and mineral content with antioxidant activity and determination of bioactive compounds in various local bananas (Musa sp.). Thesis, Universitas Diponegoro, Semarang.

Aggarwal D., Sabikhi L., Kumar M.H.S. (2016). Formulation of reduced-calorie biscuits using artificial sweeteners and fat replacer with dairy–multigrain approach.NFS J. 2: 1-7.

Aline Pereira n and Marcelo Maraschin, (2015). Banana (Musa spp) from peel to pulp: Ethnopharmacology, source of bioactive compounds and its relevance for human health . Journal of Ethnopharmacology 160(2015)149–163.

Amarnath, R and Balakrishnan, V, (2007). Evaluation of the banana (Musa paradisiaca) plant by-product's fermentation characteristics to assess their fodder potential. International Journal of Dairy Science 2: 217-225.

Amit, R and S, Shailandra,(2006). Ethnomedicinal approach in biological and chemical investigation of phytochemicals as antimicrobials. Indian Journal of Pharmaceutical Science 41:1-13.

Anhwange, B.A, (2008). Chemical Composition of Musa sapientum (Banana) peels. Journal of food technology 6(6): 263-266.

Anhwange, B.A., Ugye ans, T. J. and Nyiaatagher, T. D, (2009). Chemical composition of Musa sapientum (Banana) peels. EJEAFChe. 8: 437-442.

Anhwange, B.A., Ugye, T.J., Nyiaatagher, T.D, (2009). Chemical composition of Musa sapientum (banana) peels. Electron. J.Environ. Agric. Food Chem. 8 (6), 437–442.

Bori, M.O., Adebusoye, S. A. Lawal, A. K. and Awotiwon, A, (2007). Production of biogas from banana and plantain peels. Advanced Environmental Biology 1: 33-38.

Brooks, A.A, (2008). Ethanol production potential of local yeast strains isolated from ripe banana peels. African Journal of Biotechnology 7: 3749-3752.

Chen, J., W.C. Song and Y.S. Xu, (2007). Study on distilled dietary fiber technology from banana peel. Food Sci., 1: 99-101.

Debabandya, M., Sabyasachi, M. and Namrata, S, (2010). Banana and its by-products utilization: An overview of Journal of Science and Industrial Research 69: 323-329.

Department of Health and Ageing, (2003). A manual of mental health care in general practice: Antidepressants.

ISSN 2056-5798(Print), ISSN 2056-5801(online)

Ehiowemwenguan, G., Emoghene, A. O. and Inetianbor, (2014). Antibacterial and phytochemical analysis of Banana fruit peel. IOSR Journal Of Pharmacy. www.iosrphr.org Volume 4, Issue 8 , PP. 18-25.

Emaga, T. H., Andrianaivo, R. H., Wathelet, B., Tchango, J. T., and Paquot, M, (2007).Effects of the stage of maturation and varieties on the chemical composition of banana and plantain peels. Food Chemistry, 103(2), 590–600.

Fatemeh, S.R., Saifullah, R., Abbas, F.M.A. and Azhar, M.E, (2012). Total phenolics, flavonoids and antioxidant activity of banana pulp and peel flours: influence of variety and stage of ripeness. International Food Research Journal 19: 1041-1046.

Garzón, M.A.G., Acosta, L.M.V., Cardona, L.J.M., Hurtado, M.A.A., Rodriguez A.C.D., Taborda N.C., Gutierrez L.A.R. and Mejia, G.C.V, (2011). Desarrollo de um producto de panadería con alto valor nutricional a partir de la harina obtenida del banano verde con cáscara: una nueva opción para el aprovechamiento de residuos de la industria de exportación. Produción + Limpia 6: 96-107.

Ghorade, I.B., Jadhavar, V.R., Potadar, V.R. and Patil, S.S, (2011). Utilization of agricultural waste in organic farming for sustainable agriculture. Indian Streams Research Journal 1: 1-5.

Girish, H.V and S.Satish, (2008). Antibacterial activity of important medicinal plants on human pathogenic bacteria – a comparative analysis. World Application of Science Journal 5(3): 267-271.

Gomes, A.A.B., Ferreira, M.E. and Pimentel, T.C,(2016). Bread with flour obtained from green banana with its peel as partial substitute for wheat flour: Physical, chemical and microbiological characteristics and acceptance. International Food Research Journal 23(5): 2214-2222 .

Hettiaratchi UP. Chemical compositions and glycemic responses to banana varieties. Int J Food

Husain, M.D. and William, R,(2010). Status of banana cultivation and disease incidences in Malaysia. Crop Protection and Plant Quarantine Division, Department of Agriculture, Malaysia, pp: 60.

Igbabul Bibiana Dooshima , Amove Julius and Okoh Abah, (2014). Quality evaluation of composite bread produced from wheat, defatted soy and banana flours. International Journal of Nutrition and Food Sciences; 3(5): 471-476.

J.P. Essien, E.J. Akpan, E.P. Essien , (2005). Studies on mould growth and biomass production using waste banana peel. J.P. Essien et al. / Bioresource Technology 96 : 1451–1456.

Jahan M,(2010). Concentration influence on antimicrobial activity of banana blossom extracting corporated Chitosan polyethylene glycol (CSPEG) blended film. Journal of Chemical and Pharmaceutical.

Juárez-García E, Agama-Acevedo E, Sáyago-Ayerdi S. G, Rodríguez-Ambríz S. L. and Bello-Pérez, L. A, (2006).“Composition, Digestibility and Application in Breadmaking of Banana Flour,” Plant Foods Human and Nutrition, Vol. 61, No. 3, pp. 131-137.

Kondo, S, Kittikorn, M, Kanlayanarat, S, (2005). Preharvest antioxidant activities of tropical fruit and the effect of low temperature storage on antioxidants and jasmonates. Postharvest Biol. Technol. 36, 309–318.

Kumar, K.P.S, Bhowmik, D, Duraivel, S, Umadevi, M, (2012). Traditional and medicinal uses of banana. Journal of Pharmacognosy and Phytochemistry 1 (51-63).

Marisa M. Wall, (2006). Ascorbic acid, vitamin A, and mineral composition of banana

ISSN 2056-5798(Print), ISSN 2056-5801(online)

Mèlo, E.A, Lima,V.L.A.G, Maciel,M.I.S,(2006).Polyphenol, ascorbic acid and total carotenoid contents in common fruits and vegetables. Brazilian Journal of Food and Technology 9,89–94.

Mokbel, M., Saif, F. and Hashinaga, F, (2005). Antibacterial and antioxidant activities of banana (Musa, AAA cv. Cavendish) fruits peel. Asian Journal of Biotechnology 2: 1-4.

Mokbel, M.S, Hashinaga, F, (2004). Effect of heat, calcium chloride and modified atmosphere on the shelf life of banana fruits. Food Preserv. Sci. 30, 179–184.

MPA, (2006). Depression. Nareman S. Eshak, (2016). Sensory evaluation and nutritional value of balady flat bread supplemented with banana peels as a natural source of dietary fiber. Annals of Agricultural Science. 61(2), 229–235.

Nguyen, T. B. T, Ketsa, S and van Doorn, W. G, (2003). Relationship between browning and the activities of polyphenol oxidase and phenylalanine ammonia lyase in banana peel during low temperature storage. Postharvest Biology and Technology, 30(2), 187–193.

NIMH, (2008). Depression. NIH Publication No.083561. OECD, 2001. OECD guideline for testing of chemicals 423.

Omojasola, P.F. and Jilani, O. P, (2009). Cellulose production by Trichoderma longi, Aspergillus niger and saccharomyces cerevisae cultured on plantain peel. Research Journal of Microbiology 40: 67-74.

Perla Osorio-Díaz , José J. Islas-Hernández , Edith Agama-Acevedo , Sandra L. Rodríguez-Ambriz ,María E. Sánchez-Pardo , Luis A. Bello-Pérez,(2014). Chemical, Starch Digestibility and Sensory Characteristics of Durum Wheat/Unripe Whole Banana Flour Blends for Spaghetti Formulation. Food and Nutrition Sciences, 5, 264-270.

Ponnuswamy, V, Lekshmi, V. D. and Prakash, S. G. V,(2011). Bio-processing of banana peel for amylase production by Sp. Penicillium. Asian Journal of Biological Science 2: 257-264.

Rafaela Gonzalez-Montelongo, M. Gloria Lobo, Monica Gonzalez, (2010). Antioxidant activity in banana peel extracts: Testing extraction conditions and related bioactive compounds. Food Chemistry 119 : 1030–1039.

Ratule M.T, Osman, A, Saari, N. and Ahmad, S. H, (2007). Microstructure of peel cell wall and selected physic-chemical characteristics of Berangan banana (Musacv. Berangan [AAA]) ripened at high temperature. Asia Pacific Journal of Molecular Biology and Biotechnology 15: 8-13.

Rodriguez-Ambriz S. L., Islas-Hernández J. J., Agama-Acevedo E., Tovar J.and Bello-Pérez L. A,(2008). "Characterization of a Fiber-Rich Powder Prepared by Liquefaction of Unripe Banana Flour," Food Chemistry, Vol. 107, No. 4, pp. 1515-1521.

Sampath Kumar K. P, Debjit Bhowmik, Duraivel S and Umadevi M, (2012). Traditional and Medicinal Uses of Banana. Journal of Pharmacognosy and Phytochemistry. Volume 1 Issue 3. IC Journal No: 8192.

Sanchez-Machado D.I, Lopez-Cervantes and N.J. Rios Vazquez,(2006). High-performance liquid chromatography method to measure α-and γ- tocopherol in leaves, flowers and fresh beans from Moringa oleifera, Journal of Chromatography A, 1105, 111-114.

Sarawong C, Schoenlechner R, Sekiguchi K, Berghofer E and Perry K.W.N,(2014). Effect of extrusion cooking on the physicochemical properties, resistant starch, phenolic content and antioxidant capacities of green banana flour. Food Chemistry 143: 33-39.

Sci Nutr 2011; 62(4):307-309.

Shinichi Someya, Yumiko Yoshiki, Kazuyoshi Okubo, (2002). Antioxidant compounds from bananas (musa Cavendish). Food Chemistry 79: 351–354.

ISSN 2056-5798(Print), ISSN 2056-5801(online)

Silva E.M, souza J.N.S, Rogez, H, Rees J.F. and Larondelle Y. (2006). Antioxidant activity and Polyphenolic contents of fifteen selected plant species from the Amazonian region. Journal of food chemistry 101, 1012-1018.

Someya S, Yoshiki Y and Okubo K, (2002). Antioxidant compounds from bananas (Musa Cavendish). Food Chemistry, 79(3), 351–354.

SPSS, (2010). Statistical package for social science computer software version 19 (USA) on an IBM, PC Computer Bailey.

Subbaiah K.V, Jagadeesh S.L, Reddy S and Kanamadi V.C, (2013). Effect of varieties and pre-treatments on physico-chemical and sensory quality of banana papads. Karnataka Journal of Agricultural Science 26: 115-118.

Sulaiman S.F, Yusoff N.A.M, Eldeen I.M, Seow E.M, Sajak A. A.S, Ooi K.L , (2011). Correlation between total phenolic and mineral contents with antioxidant activity of eight Malaysian bananas (Musa sp.). J. Food Compos. Anal. 24, 1–10.

Sun J, (2002). Antioxidant and antiproliferative activities of common fruits. J Agric Food Chem; 50(25):7449-54.

Tan Pei Tee and Halijah Hassan, (2011). Antidepressant-Like Activity of Banana Peel Extract in Mice. American Medical Journal 2 (2): 59-64.

Tavakkoli Kakhki M, Motavasselian M ,Mosaddegh M, Esfahani M.M, Kamali nejad M , Nematy M, Eslami S,(2014).Omega-3andomega-6contentof medicinal foods for depressed patients: implications from the Iranian Tradi tional Medicine.Avicenna Journal of Phytomedicine 4,225–230.

Thomas Happi Emaga, Christelle Robert, Sebastien N, Ronkart, Bernard Wathelet and Michel Paquot, (2008). Dietary fiber components and pectin chemical features of peels during ripening in banana and plantain varieties. Bioresource Technology 99 : 4346–4354.

Velumani S, (2016). Phytochemical screening and antioxidant activity of banana peel. IJARIIE-ISSN(O)-2395-4396. Vol-2 Issue-1. WHO, (2010). Depression.

Yang F.Q, and Ito Y. (2002).Preparative separation of lappaconitine, ranaconitine, Ndeacetyllappaconitine and N- deacetylranaconitine from crude alkaloids of sample Aconitum sinomontanumnakai by high speed counter current chromatography, journal of chromatography A, 943, 219- 225.

Zar J.H, (1984). Biostatistical Analysis, second ed. Prentice-Hall, Englewood Cliffs, NJ.

Zenab M, Mosa, Ayman F, Khalil, (2015). The effect of banana peels supplemented diet on acute liver failure rats. Annals of Agricultural Science 60(2), 373–379.

Zhang P, Whistler R.L, BeMiller J.N, Hamaker B.R,(2005). Banana starch: production, physicochemical properties, and digestibility review. Carbohyd. Polym. 59, 443–458.

ISSN 2056-5798(Print), ISSN 2056-5801(online)