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HERBS AND SPICES, AN ANTICANCER POTENTIAL

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ABSTRACT
The advancement of today's technology paved the way to a more challenging lifestyle and the preference to prolong lifespan by staying healthy and be free of any illness especially cancer. The research was conducted to evaluate the antioxidative potentials and total phenolics of some medicinal herbs and spices as a possible prevention for cancer. The antioxidative potentials of these herbs and spices were measured in terms of Oxidation Protection Efficiency (OPE) while the total phenolics were determined as parts per million Gallic Acid Equivalent (ppm GAE). There were four sampling periods with triplicates per sample and the collection of the data were done following the modified thiocyanate method [2] for asessing the antioxidant activity of the sample under study. The t-test, regression analysis and one-way ANOVA were used to assess the statistical significance of the OPEs, total phenolics in ppm GAE and the correlation between the OPE and GAE. The herbs and spices studied were *Capsicum annuum* (pepper); *Coleus amboinicus* (Indian borage or locally called oregano); *Cymbopogon citratus(DC) Stapf*, (lemon grass); *Pandanus amaryllifoius Roxb* (pandan); *Allium sativum* (leeks); *Allium sativum L* (garlic); *Zingiber officinale Roscoe* (ginger); *Allium cepa L* (onion); *citrus limon* (lemon) and *Atuna racemosa Rafin.Chrysobalanaceae*, (canopy/emergent fruit or locally known "tabon-tabon"). Of these ten samples studied, *Zingiber officinale Roscoe* (ginger) and *Coleus amboinicus* (Indian borage or locally called oregano) were statistically shown to have high OPE values as compared to the other samples tested while *Atuna racemosa Rafin.Chrysobalanaceae* (canopy/emergent fruit) and *Pandanus amaryllifoius Roxb* (Pandan) remarkably showed high equivalent values for phenolics content. In addition, the results showed that the antioxidative potentials of herbs and spices may not only be due to its total phenolics but also to the other groups of phytochemicals present. This finding marks a significant contribution as a prevention of cancer especially that these herbs and spices are readily available and can be found as condiments to any cooking procedure. These herbs and spices as found in a dish can be an anticancer specialist in every meal.

KEY WORDS: antioxidants, phenolics, Oxidation Protection efficiency, phytochemicals, carcinogens.

INTRODUCTION

As the body ages or is subjected to environmental pollutants, such as cigarette smoke, overexposure to sunlight, or smog, the body becomes overwhelmed by free radicals. An excessive number of free radicals cause damage by taking electrons from key cellular components of the body, such as protein, lipids, and deoxyribonucleic acid (DNA), the molecule that carries genetic information in every living cell. These reactions make cells more vulnerable to cancer-causing chemicals, called carcinogens. Antioxidants are molecules that neutralize the free radicals that damage living cells. They can take the form of enzymes in the body, vitamin supplements, and a component of food intake or industrial additives to food. Dietary antioxidants supplement the action of enzymes that occur naturally in the body, and some studies show that a diet high in foods that are rich in antioxidants may decrease the risk of cancer and heart disease. Research findings[3, 7]of the antioxidative capacities of selected Philippine edible plant leaves and fruit peels respectively showed that extract from *Pisonia alba Span* (lettuce tree) and *Capsicum anuum Linn*. (green hot pepper) among edible plants had higher Protective Values (PVs) while *G. mangostana* (mangosteen) is topping the list of a very high OPE values compared to the other fruit peels under study. Recently, herbs and spices have also been identified as sources of various phytochemicals, many of which possess important antioxidant activity [6, 10, 13, 14, 18, 20]. Antioxidants are widely known to cure cancer. Researchers have begun to formally study the health benefits of herbs and spices as a possible prevention for cancer. A number of researches use different methods of assessing the total antioxidant capacity of some dietary plants. Among others are the TEAC assay of Miller, the FRAP assay of Benzie and Strain, the ORAC assay of DeLange and Glazer [9], the Briggs-Rauscher reaction [5], and the Ferric Thiocyanate method of Osawa and Namiki[2]. This research was conducted to evaluate the antioxidative potential expressed as Oxidation Protection Efficiency (OPE) and total phenolics as parts per million Gallic Acid Equivalent (ppm GAE), of some common herbs and spices, and to establish relationship between the antioxidative potentials and total phenolics among these herbs and spices.

MATERIALS AND METHODS

The research was done in Cagayan de Oro City, Philippines and the samples were randomly collected at the same place. The sampling for each of the ten herbs and

spices was conducted four times, with three trials per sampling, during the study period of about a month. Figure 1 shows the pictorial presentation of the different samples being studied.

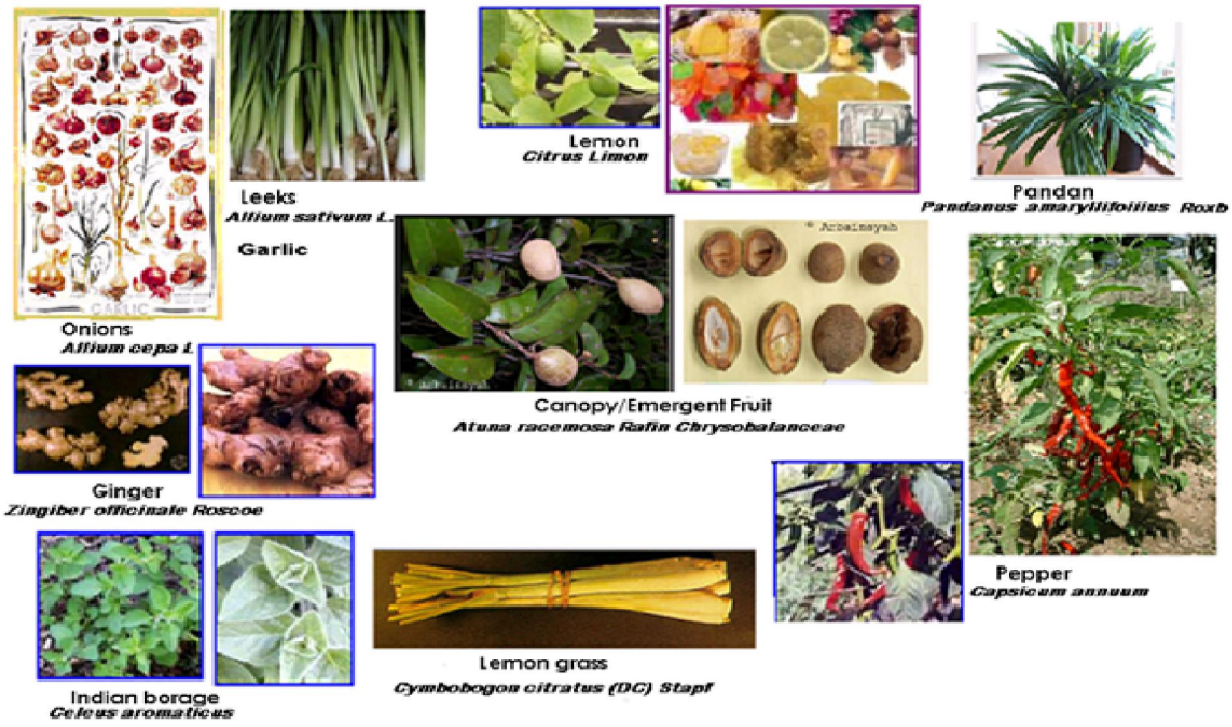

FIGURE 1. Pictures of the Samples under study

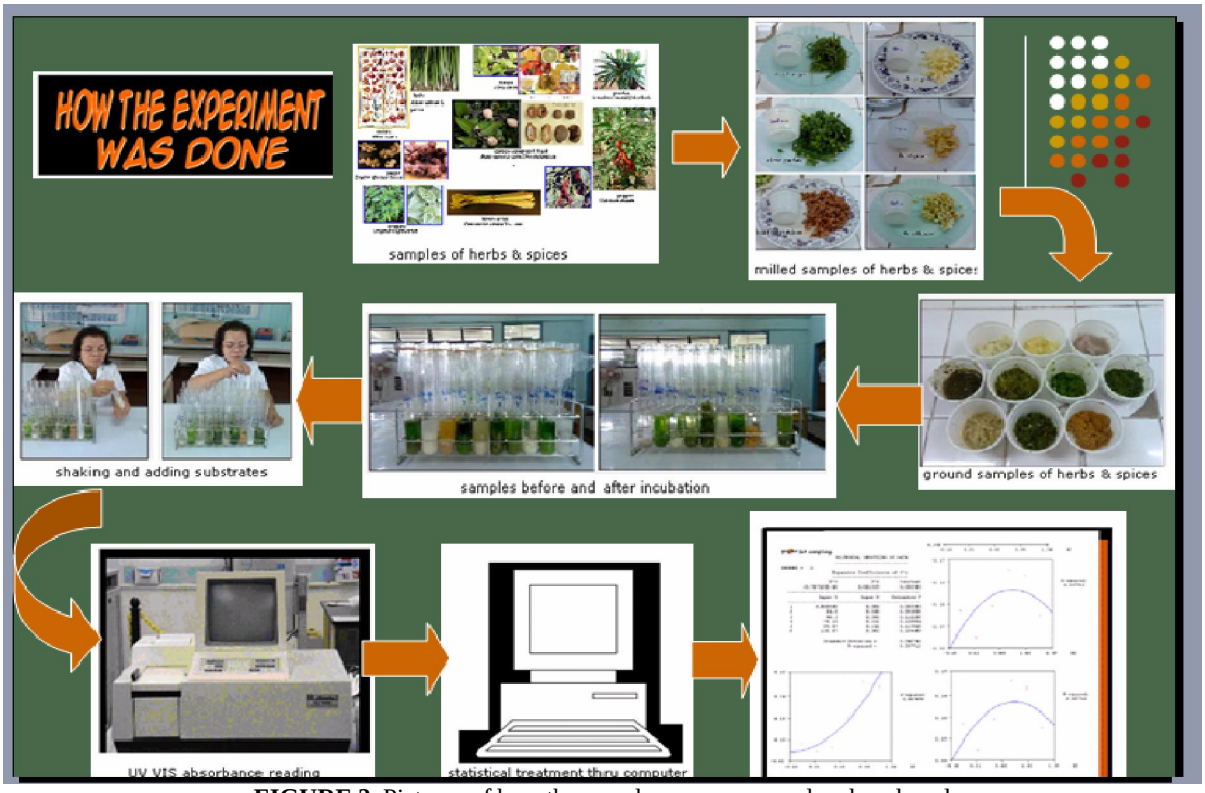

FIGURE 2. Pictures of how the samples were prepared and analyzed

The collected samples were washed and cleaned before extraction with methanol as solvent. The prepared extracts were each added to a substrate mixture containing linoleic acid to determine the antioxidative potential based on the modified thiocyanate method [2]. In this research, a thiocyanate method was used for the determination of the

antioxidative potentials since it was more economically feasible. For phenolics, the use of Folin-Ciocalteu reagent, readily available in the laboratory, was carried out. Both procedures employed spectrophotometric measurements.

Figure 2 showed the procedure of how the method was carried to determine the antioxidative potential and phenolics content of the ten samples.

A control was run each time with just the solvent instead of the extract. The progress of oxidation was then monitored in terms of absorbance for five days. The curves for the oxidation trends were determined using polynomial regression. From the curves, areas were calculated to serve as basis for calculating OPEs.

From the areas obtained, the Oxidation Protection Index (OPI) and Oxidation Protection Efficiency (OPE) were calculated as follows:

$$OPI = \frac{\text{Control Curve Area} - \text{Sample Curve Area}}{\text{Control Curve Area}}$$

$$OPE = OPI \times 100\%$$

The total phenolics determinations were done on portions of the extracts and were based on the average absorbance readings at 740 nm from which the concentrations as ppm GAE were computed.

RESULTS AND DISCUSSION

The results of the average Oxidation Protection efficiency (OPE) for each of the ten samples were compared and the coefficient of variations were computed and analyzed.

TABLE 1. Mean OPE values, standard deviations and coefficients of variation of herbs and spices

Name of Herbs & Spices	OPE	SD	CV %
1. *Zingiber officinale Roscoe* (ginger)	91.88	8.05	8.76*
2. *Coleus amboinicus* (Indian borage)	72.77	38.42	52.80*
3. *Pandanus amaryllifoius Roxb* (pandan)	49.54	32.03	64.65*
4. *Capsicum 493itra* (pepper)	41.91	21.08	76.35*
5. *Atuna racemosa Rafin. Chrysobalanaceae* (canopy/emergent fruit)	36.79	48.15	130.88
6. *Cymbopogon 493itrates(DC) Stapf* (lemon grass)	25.15	43.32	172.25
7. *Citrus limon* (lemon)	24.46	18.12	74.08*
8. *Allium sativum L* (garlic)	11.32	24.03	212.28
9. *Allium sativum* (leeks)	8.96	14.65	163.50
10. *Allium cepa L* (onion)	1.96	26.31	1342.25

*significant CV

Based on the tabulated data (Table 1), the results according to the obtained OPE values indicated that *Zingiber officinale Roscoe* (ginger) and *Coleus amboinicus* (Indian borage or locally called oregano) are the best herbs and spices with a very strong antioxidative potential. The order of decreasing OPE values has been followed by *Pandanus amaryllifoius Roxb* (pandan), *Capsicum annuum* (pepper), *Atuna racemosa Rafin. Chrysobalanaceae* (canopy/emergent fruit or locally known as “tabon-tabon”), *Cymbopogon citrates* (DC) *Stapf* (lemon grass), citrus limon (lemon), *Allium sativum L.* (garlic), *Allium sativum* (leeks) and the least *Allium cepa L.* (onion).

TABLE 2. Calculated t-test & p-value of the mean OPE of herbs and spices

Name of Herbs & Spices	OPE	Calculated t	P-value
1. *Zingiber officinale Roscoe* (ginger)	91.88	19.77	0.0025*
2. *Coleus amboinicus* (Indian borage)	72.77	3.79	0.0323*
3. *Pandanus amaryllifoius Roxb* (pandan)	49.54	3.09	0.0536
4. *Capsicum annuum* (pepper)	41.91	2.62	0.0791
5. *Atuna racemosa Rafin. Chrysobalanaceae* (canopy/emergent fruit)	36.79	1.53	0.2239
6. *Cymbopogon citratus(DC) Stapf* (lemon grass)	25.15	1.16	0.3296
7. *Citrus limon* (lemon)	24.46	2.70	0.0738
8. *Allium sativum L* (garlic)	11.32	0.94	0.4157
9. *Allium sativum* (leeks)	8.96	1.22	0.3080
10. *Allium cepa L* (onion)	1.96	0.15	0.8911

*statistically significant at 0.05

Furthermore, based on t-test results (Table 2), only the OPE values of *Zingiber officinale Roscoe* (ginger) and *Coleus amboinicus* (Indian borage or locally called oregano) are statistically significant relative to an OPE value of zero that indicates an absence of antioxidative potential. The nonsiginificance of the OPEs of the other herbs and spices could have been due to the wide variation in results from sample to sample as shown by the coefficient of variation, CV values (Table 1). Many factors could have been the cause of the variation like the exact source of material, age from harvesting time, varietal differences and uncontrollable environmental conditions since these were not considered during the study. Surprisingly though, *Zingiber officinale Roscoe* (ginger) has exhibited a relatively more uniform OPEvalues based on low CV value.

TABLE 3. Average total phenolics among herbs and spices.

Name of Herbs & Spices	ppm in extracts	ppm as GAE
1. *Atuna racemosa Rafin. Chrysobalanaceae* (canopy/emergent fruit)	154.5	5388
2. *Pandanus amaryllifoius Roxb* (pandan)	83.9	2928
3. *Citrus limon* (lemon)	58.7	2049
4. *Capsicum annuum* (pepper)	57.4	2004
5. *Zingiber officinale Roscoe* (ginger)	53.8	1878
6. *Cymbopogon citratus(DC) Stapf* (lemon grass)	51.7	1803
7. *Allium sativum L* (garlic)	34.1	1190
8. *Allium cepa L* (onion)	33.8	1178
9. *Allium sativum* (leeks)	27.4	956
10. *Coleus amboinicus* (Indian borage)	25.0	874

Table 3 shows the relative total phenolics of the samples in ppm as GAE based on the absorbance at 740 nm. The values as shown indicated that *Atuna racemosa Rafin.Chrysobalanaceae*, (canopy/emergent fruit or locally known as 'tabon-tabon') has the highest total phenolics with an equivalent value of 5388 parts per million, while *Pandanus amaryllifoius Roxb* (pandan) and *citrus limon* (lemon), rank second and third with total phenolics equivalent of 2928 and 2049 ppm respectively

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TABLE 4. Regression analysis and one-way ANOVA of OPE versus total phenolics in ppm GAE

The regression equation is OPE = 31.4 + 0.00252 ppm				
Predictor	Coef	SE Coef	T	P
Constant	31.6	18.05	1.74	0.121
ppm	0.002519	0.007555	0.33	0.747
S = 30.29 R-Sq = 1.4% R-Sq(adj) = 0.0%				
Analysis of Variance				
Source	DF	SS	MS	F	P
Regression	1	102.0	102.0	0.11	0.747
Residual Error	8	7341.9	917.7		
Total	9	7443.9			

However, the results of the regression analysis and one-way ANOVA (Table 4) provide an F value of 0.11 with a p-value of 0.747 which means that the relationship between the total phenolics and antioxidative potential among herbs and spices is not statistically significant. The antioxidative potentials of the herbs and spices do not correlate with the total phenolics. While phenolics generally exert antioxidative potentials, there may be other groups of substances that strongly affect the antioxidative potentials of herbs and spices [11, 13]. Thus, the total phenolics are not a predictor of the antioxidative potentials of the herbs and spices under study.

The result points to the fact that the phenolics content among herbs and spices is just one of the many groups of phytochemicals that has antioxidant activity[17, 18]. Other phytochemicals with antioxidant activity are allyl sulfides where *Allium cepa L* (onion), *Allium sativum* (leeks) and *Allium sativum L* (garlic) are classified not to mention carotenoids, flavonoids and polyphenols [1]. The data also proved that *Zingiber officinale Roscoe* (ginger) and *Coleus amboinicus* (Indian borage or locally called oregano), though higher in antioxidative potentials, has low total phenolics while *Atuna racemosa Rafin.Chrysobalanaceae*, (canopy/emergent fruit or locally known "tabon-tabon") has the highest total phenolics.

CONCLUSION

From the summary of findings one can therefore conclude that some of the samples tested contain antioxidative activities and phenolics compound based on the OPE values and the ppm as GAE values. But from among the samples of herbs and spices under study, *Zingiber officinale Roscoe* (ginger) has shown to have a very significant value of OPE and is a strong antioxidant. This is followed by *Coleus amboinicus*, (Indian borage or locally called oregano) which also showed significant values of OPE. While the rest of the samples, though has OPE values greater than one, but are not statistically significant. The OPE values points to the fact that they are relatively weak or there were no antioxidants at all in terms of the values given. On the other hand, *Atuna racemosa Rafin. Chrysobalanaceae* (canopy/emergent fruit or locally known as 'tabon-tabon') showed a high value of phenolics content, followed by *Pandanus amaryllifoiius Roxb*, (pandan) and *Citrus Limon* (lemon). Moreover, there is no significant relationship in terms of the antioxidative activities and phenolics content among samples of herbs and spices. The phenolics content alone of herbs and spices is not a predictor of its antioxidant activities. The result can be due to the different classes of phytochemicals acting as antioxidants present in the herbs and spices [12]. It is also possible that the kind of method used to detect the antioxidant activity probably did not respond to the class of compounds present in the chosen sample of herbs and spices [9]. The result has been consistent with all the samples under the specie, *allium sp.*

RECOMMENDATION

In the light of the above conclusions, it is recommended that families of every household should take the time in including spices and herbs in the preparation of food for the family members to have cancer prevention, most especially *Zingiber officinale Roscoe* (ginger) and *Coleus amboinicus*, (Indian borage or locally called oregano) whose antioxidative potential is found to be statistically significant. Quite a number of recipes with spices and herbs as part of the condiments are already available commercially. It will serve as a guide for the cooks in every household to have an anticancer specialist in the kitchen. With the limitations of the researcher's capacity to conduct a full assay in vivo and in vitro of the antioxidative activities of herbs and spices, a recommendation of such will further enhance the results of this finding. Another area of concern for those interested with antioxidants is to consider the maturity and area of cultivation of the samples of herbs and spices. In as much as the samples were randomly bought in the market, the maturity of the samples and place where they were grown were not considered. Though the results confirmed the high OPE values of *Zingiber officinale Roscoe* (ginger) despite the method of sampling, the result is conclusive enough for the strong antioxidative potential of this specie, regardless of maturity and location. On the other hand, the high OPE values of *Coleus amboinicus* (Indian borage or locally called oregano) and the high total phenolics of *Pandanus amaryllifoiius Roxb* (pandan) is also conclusive since these samples were taken from the same place at different sampling periods. Another subject of interest would be a comparison of the different methods of detecting antioxidant activities among samples of herbs and spices to produce a conclusive result. Furthermore, a thorough study of the chemical component especially found in *Atuna racemosa Rafin.Chrysobalanaceae* (canopy/emergent fruit or locally known as "tabon-tabon") can be a subject for further research since it contains the highest value of total phenolics.

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REFERENCES

[1]. American Journal of Clinical Nutrition (1999) Vol. 70, No. 3, 491S-499S, September.

[2]. Anggadiredja, J., Andyani, R., Hayati, Muawanah. (1997) Antioxidant Activity of Sargassum Polyaystum (Phaeophyta) and Laurencia Obtusa (Rhodophyta) from Seribu Islands. Journal of Applied Phycology 9, 477-479.

[3]. Auxilio, Anthony R.(2003) Antioxidative Capacities of Selected Philippine Edible Plant Leaves. MPSC Research Journal, Volume 3 No.1. ISSN No. 1655-597X.

[4]. Craig, Winston J.(1999) Health-promoting properties of common herbs, Am J Clin Nutr70(suppl):491S-9S. Printed in USA. C1999 American Society for Clinical Nutrition. [On line] available: http:/www.ajcn.org.

[5]. Cervellati R, Renzulli C.,Guerra MC., Speroni E.(2002) Evaluation of antioxidant activity of Some Natural Polyphenolic Compounds using the Briggs-Rauscher reaction Method, J Agric Food Chem 200 Dec8:50(26):7504-9.

[6]. Dragland, Steinar; Senoo,Haruki ; Wake, Kenjiro; Holte, Kari and Blomhoff, Rune(2003) Several Culinary and Medicinal Herbs are Important Sources of Dietary American Society for Nutritional Sciences.16 January.

[7]. Del Rosario, Romeo M. and Palmes, Nenita D.(2006) Pro-oxidants, Antioxidants, and Fruit By-products 21st Philippine Chemistry Congress, Ateneo de Davao University, Davao City, Philippines. 4th-7th, April.

[8]. Elliott Middleton, Jr., Chithan Kandaswami and Theoharis C.Theoharides(2000).The Effects of Plant Flavonoids on Mammalian Cells:Implications for Inflammation, Heart Disease, and Cancer, Vol. 52, Issue 4, 673-751, December .

[9]. Halvorsen, Holte, Myhrstad, Barikmo, Hvattum, Remberg, Wold, Haffner, Baugerod, Andersen, Moskaug, Jacobs and Blomhoff , (2002).

[10]. Ingels, Darin, ND (2002). Check Your Cupboard: Everyday Spices May Improve Your Health,Healthnotes Newswire. March 14.

[11]. Kähk nen, Marja P., Hopia, Anu I., Vuorela, Heikki J., Rauha, Jussi-Pekka, Pihlaja, Kalevi, Kujala, Tytti S., & Heinonent, Marina (1999) Antioxidant Activity of Plant Extracts Containing Phenolic Compounds J. Agric. Food Chem., Vol. 47, No. 10.

[12]. Lampe, Johanna W.(2003) Spicing up a Vegetarian Diet: Chemopreventive Effects of Phytochemicals American Journal of Clinical Nutrition, Vol. 78, No. 3, 579S-583S, September.

[13]. Llorach R, Espin JC, Tomas-Barberan FA, Ferreres F, (2002) Artichoke (Cynara scolymus L.) Byproducts As A Potential Source of Health-promoting Antioxidant Phenolics. J Agric Food Chem. Jun 5;50(12):3458-64.

[14]. Nakatani, Nobuji (1994) Antioxidative and Antimicrobial Constituents of Herbs and Spices. Spices, Herbs and Edibal Fungi, Elsevier Science B.V:251-271.

[15]. Ninfali, Paolino; Mea, Gloria; Giorgini, Samantha ; Rocchi, Marco; Bacchiocca, Mara(2005). Antioxidant capacity of vegetables, spices and dressings relevant to nutrition .British Journal of Nutrition, Volume 93, No.2 February 2. Pp257-266. http://www.wholefoodsmarket.com/flavors/index.html

[16]. Romano, Jeannie A.(2004) Medicinal Plants of Tacurong, Sultan Kudarat: Uses, Applications, Preparations and Diversity, MSU-IIT, Iligan City October.

[17]. Sahelian, Ray M.D.(2006) Phenolic Compounds and Phenolic Acids. Methods Find Exp Clin Pharmacol. (3):157-60. Industrial Farmaceutica Cantabria, Arequipa 1, Madrid, Spain Apr;28

[18]. Shiow Y. Wang (2002) Antioxidants and Phenols Defined. USDA's Beltsville Agricultural Research Center, Beltsville, Maryland. Life SN22236 May.

[19]. Takuji Tanaka, Hiroyuki Kohno, Hideki Mori., Chemoprevention of Colon Carcinogenesis by Dietary Nonnutritive Compounds, First Department of Pathology, Kanazawa Medical University, 1-1 Daigaku, Uchinada-cho, Kahokugun,Ishikawa 920-0293, Japan

[20]. *Tapsell LC*, *Hemphill I*, *Cobiac L*, *Fenech M*, et al (2006). Health benefits of herbs and spices: the past, the present, the future. Medical Journal of Australia. Pyrmont: Aug 21. Vol. 185, Iss. 4; pg. S1, 22 pgs.