B. Antioxidant activity

1) DPPH free radical scavenging activity

The measurement of DPPH free radical scavenging activity is based on the DPPH radicals reduction in ethanol which causes an absorbance drop at 515 nm [2]. The solution color changes from purple to yellow. This change occurs when DPPH was captured by antioxidants which remove H atoms to form a stable DPPH-H [24].

The DPPH free radical scavenging activity of *C. rotundus* rhizome and areca seed are shown in Figure 2. It indicates that the type of solvent gave a different antioxidant activity of extracts. According to [19], the polarity will determine the extraction result and antioxidant activity contained in the extract. Aqueous extract of areca seed showed higher antioxidant activity (76.64%) than ethanol extract (66.82%). However, solvent type has no effect on the antioxidant activity of the rhizome of *C. rotundus*. Both water and ethanol extracts of *C. rotundus* rhizome exhibited the same level of the antioxidant activities (64.67% and 64.16%, respectively).

Generally, extracts that contain a high amount of polyphenols also show high antioxidant activity. In contrast, ethanol extract of areca seed had higher total polyphenol content than water extract, but it showed lower DPPH free radical scavenging activity than aqueous extract. It could be due to the presence of compounds not reactive to DPPH. Antioxidant compounds such as polyphenols may be more efficient as reducing agents for ferric iron but some may not scavenge DPPH free radicals as efficiently because of steric hindrance [2].

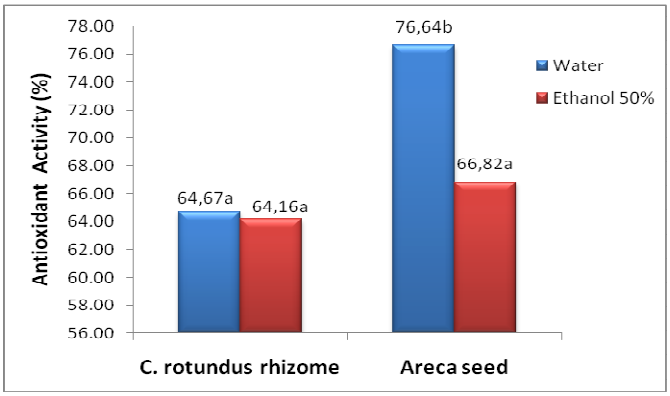

Fig. 2 The interaction effect of natural antioxidant extracts and solvent types on antioxidant activity (values followed by the same letter indicate no significant differences)

2) Reducing Power

Level-3 Heading: A level-3 heading must be indented, in In the reducing power measurement, the reductant (antioxidant) in the sample will reduce Fe^{3+} ions (potassium ferricyanide complex [$(K_3Fe(CN)_6]$) to the ions Fe^{2+} (ferrous form)). Therefore, Fe^{2+} can be monitored by measuring the formation of Perl's Prussian blue at 700 nm. Increased absorbance indicated an increase in the reducing power [1], [23].

As shown in Figure 3, ethanol extract of the rhizome of *C. rotundus* exhibited a higher reducing power than water extract. This result correlated positively with the total polyphenol content. High content of total polyphenols showed a high reducing power of the rhizome of *C. rotundus* extract. However, there was no difference in the reducing power of the areca seed. Both water and ethanol extracts of the the areca seed have a same level of the reducing power. The results reveal that both *C. rotundus* rhizome and areca seed are electron donors and could react with free radicals, convert them to more stable products, and terminate radical chain reaction.

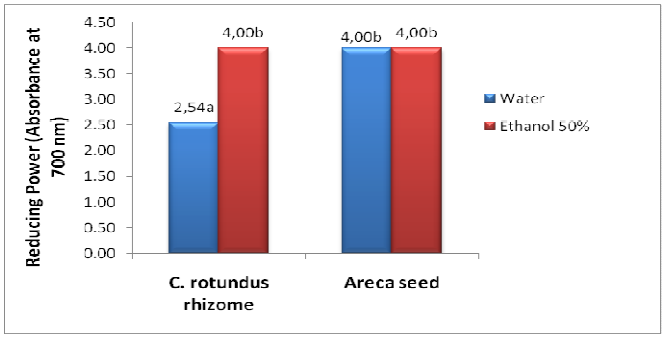

Fig. 3 The interaction effect of natural antioxidant extracts and solvent types on reducing power (values followed by the same letter indicate no significant differences)

IV. Conclusions

The results obtained in the present study indicated that both *Cyperus rotundus* rhizome and *Areca catechu* seed extracted using ethanol contain a higher amount of polyphenols than aqueous extracts. Total polyphenol extract of *C. rotundus* rhizome had a positive correlation with ferric reducing power. However, both ethanol and water extracts of *C. rotundus* rhizome had the same ability to scavenge DPPH free radicals. In contrast, there were different trends in the antioxidant activity of areca seed extract. The ethanol extract of areca seed contain a higher amount of total polyphenols than the water extract, but it showed lower antioxidant activity to scavenge DPPH free radicals. However, both ethanol and aqueous extracts of areca seed showed the same level of ferric reducing power. Further research is required to isolate and identify the antioxidative components in *C. rotundus* and areca seed.

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References

[1] L. S. Lai, S. T. Chou, and W. W. Chao, "Studies on the antioxidative activities of Hsian-tsao (Mesona procumbens Hemsl) leaf gum", J. Agric. Food Chem, vol. 49, pp. 963-968, 2001.

[2] S. P. Wong, L. P. Leong, and J. H. W. Koh, "Antioxidant activities of aqueous extracts of selected plants. Food Chemistry", vol. 99, pp. 775–783, 2006.

[3] O. Gortzi, S. Lalas, I. Chinou, and J. Tsaknis, "Reevaluation of antimicrobial and antioxidant activity of Thymus spp. extracts before and after encapsulation in liposomes", Journal of Food Protection, vol. 69 (12), pp. 2998-3005, 2006.

[4] F. M. Nor, S. Mohamed, N. A. Idris, and R. Ismail, "Antioxidative properties of Pandanus amaryllifolius leaf extracts in accelerated oxidation and deep frying studies", Food Chemistry, vol. 110, pp. 319-327, 2008.
[5] D. Jeyapragash, P. Subhashini, S. Raja, K. Abirami, and T. Thangaradjou, "Evaluation of in-vitro antioxidant activity of seagrasses: signals for potential alternate source", Free Radicals and Antioxidants, vol. 6 (1), pp. 77-89, 2016.
[6] C. Proestos, I. S. Boziaris, G. J. E. Nychas, and M. Komaitis, "Analysis of flavanoids and phenolic acids in Greek aromatic plants: investigation on their antioxidant capacity and antimicrobial activity", Food Chemistry, vol. 95, pp. 664-671, 2006.
[7] A. A. Elzaawely, T. D. Xuan, H. Koyama, and S. Tawata, "Antioxidant activity and contents of essential oil and phenolic compounds in flowers and seeds of Alpinia zerumbet (Pers.) B.L. Burtt. & R.M. Sm", Food Chemistry, vol. 104, pp. 1648-1653, 2007.
[8] Y. Jiao, Y. Jiang, W. Zhai, and Z. Yang, "Studies on antioxidant capacity of anthocyanin extract from purple sweet potato (Ipomea batatas L.)", African Journal of Biotechnology, vol. 11 (27), pp. 7046-7054, 2012.
[9] R. L. Prior, "Fruits and vegetables in the preventation of cellular oxidative damage", Am. J. Clin. Nutr, vol. 78, pp. 570-578, 2003.
[10] R. Saad, F. Asmani, M. Saad, M. Hussain, J. Khan, M. Kaleemullah, N. B. Othman, A. Tofigh, and E. yusuf, "A new Approach for Predicting Antioxidant Property of Herbal Extracts", International Journal of Pharmacognosy and Phytochemical Research, vol. 7 (1), pp. 166-174, 2015.
[11] U. Złotek, U. Szymanowska, B. Baraniak, and M. Karaś, "antioxidant activity of polyphenols of adzuki bean (*Vigna angularis*) germinated in abiotic stress conditions**",** Acta Sci. Pol. Technol. Aliment, vol. 14 (1), pp. 55–62, 2015.
[12] U. Szymanowska, U. Złotek, M. Karaś, and B. Baraniak, "Anti-inflammatory and antioxidative activity of anthocyanins from purple basil leaves induced by selected abiotic elicitors", Food Chem, vol. 172, pp. 71–77, 2015.
[13] M. A. A. Alwahsh, M. Khairuddean, and W. K. Chong, "Chemical constituents and antioxidant activity of *Teucrium barbeyanum* Aschers", Rec. Nat. Prod, vol. 9 (1), pp. 159-163, 2015.
[14] P. Khanthapok, A. Muangprom, and S. Sukrong, "Antioxidant activity and DNA protective properties of rice grass juices", ScienceAsia, vol. 14, pp. 119-129, 2015.
[15] N. Singh, B. R. Pandey, P. Verma, M. Bhalla, and M. Gilca, "Phyto-pharmacotherapeutics of *Cyperus rotundus* Linn. (*Motha*): an overview", Indian Journal of Natural Products and Resources, vol. 3 (4), pp. 467-476, 2012.
[16] A. Bashir, B. Sultana, F. H. Akhtar, A. Munir, M. Amjad, and Q. U. Hassan, "Investigation on the antioxidant activity of Dheela Grass (*Cyperus rotundus*)", African Journal of basic & Applied Sciences, vol. 4 (1), pp. 01-06, 2012.
[17] Z. Xing, W. Jiao, H. Zhuang, M. Wen-li, and D. Hao-fu, "Antioxidant and cytotoxic Phenolic Coumpounds of Areca Nut (Areca catechu)". Chem. Res. Chinese Universities, vol. 26 (1), pp. 161-164, 2010.
[18] D. Villano, M. S. F. Pachon, A. M. Troncoso, and M. C. G. Parrilla, "Comparison of antioxidant activity of wine phenolic compounds and metabolites in vitro", Analytica Chimica Acta, vol. 538, pp. 391-398, 2005.
[19] N. Safriani, N. Arpi, and N. M. Erfiza, "Potency of curry (*Murayya koeniigi*) and salam (*Eugenia polyantha*) leaves as natural antioxidant sources", Pakistan Journal of Nutrition, vol. 14 (3), pp. 131-135, 2015.
[20] L. P. Leong, and G. Shui, "An Investigation of antioxidant capacity of fruit in Singapore markets". J. Agric. Food Chem, vol. 76, pp. 69-75, 2001.
[21] C. Y. Hung, and G. C. Yen, "Antioxidant activity of phenolic compounds isolated from Mesona Procumbens Hemsl", J. Agric. Food Chem, vol. 50, pp. 2993-2997, 2002.
[22] S. Burda, and W. Oleszek, "Antioxidant and antiradical activities of flavonoids", J. Agric. Food Chem, vol. 49, pp. 2774-2779, 2001.
[23] G. C. Yen, and H. Y. Chen, "Antioxidant activity of various tea extracts in relation to their antimutagenicity". J. Agric. Food Chem, vol. 43, pp. 27-32, 1995.
[24] N. Nenadis, and M. Tsimidou, "Observations on the estimation of scavenging activity of phenolic compounds using rapid DPPH test", J. Am. Oil. Chem. Soc, vol. 79, pp. 1191-1195, 2002.