Mintage Journal of Pharmaceutical & Medical Sciences

Vol 8, Suppl 1 Jan-Mar, 2019 ISSN: 2320-3315

Review Article

ERYTHRINA VARIEGATA LINN: A REVIEW ON PHYTOCHEMISTRY, PHARMACOLOGICAL CHARACTERISTIC

LISNA GIANTI[1], RESMI MUSTARICHIE[1], ADE ZUHROTUN[2],

[1]Departement of Pharmaceutical Analysis and Medicinal Chemistry.[2]Departement of Pharmaceutical Biology, Faculty of Pharmacy, Padjadjaran University, Bandung, Indonesia.Email:lisna17002@mail.unpad.ac.id

Received - 23.09.2018; Reviewed and accepted – 31.01.2019

ABSTRACT

Background: *Erythrina Variegata* plant has properties to cure various diseases including effective as antidiabetic, cardiac depressant, anticovulsant, antimalarial, analgesic and anti-inflammatory. *Erythrina Variegata* contains alkaloids, flavonoids, triterpenoids and lectins. As well as containing the compounds of the isoflavone derivative Genistein which can prevent osteoporosis. The new isoflavonoid compounds, namely Eryvarins V, W and X from the extract of E. variegata root as a potential antibacterial. Ethanol extract of leaves and E. variegata water fraction with a concentration of 10% can significantly nourish hair. This article covers phytochemical aspects and pharmacological characteristics of the E. variegate plant as an attempt to further research. Conclusions: From the results of the research pharmacologically, compounds that are effective as anti-alopecia have not been found so it is necessary to identify compounds in *Erythrina Variegata* which are effective as anti-alopecia.

Keyword: *Erythrina Variegata* , Antialopecia, Fabaceae.

INTRODUCTION

Erythrina Variegata Linn. known as a coral tree, which grows fast and is good in tropical climates. This species can be found in Taiwan, Southern China, Philippines, Indonesia, Malaysia, Southeast Asia, India and Africa [1]. *Erythrina Variegata* has a distinctive flower that is not scented, strong and elastic, the leaves are 4-25 x 5-30 cm long with leaf stalks 2 to 28 cm long in green or light green and yellow. E. variegata trees have a height of 3 - 27 m with fluted stems and many branched stems and very bright branches. In the spring before the leaves appear, trees with red flowers with brown seeds or seeds of poisonous E. Variegata [2]. Erythrina variegate is one of the plants that has been colonized by the Indonesian government in traditional medicine, comfortable as an antimalarial, antidiarrheal and antipyretic. The part of the plant in medicine is the bark, leaves, roots and seeds. This chemical contains alkaloids, tannins, flavonoids, and resins [3].

Taxonomy

Kingdom: Plantae - Plants
Division: Magnoliophyta – Flowering plants
Class: Magnoliopsida – Dicotyledons
Family: Fabaceae (Legume family)
Subfamily: Papilionoideae
Genus: Erythrina L. – Coral Tree
Species: E. variegata L.

Scientific Name

Erythrina corallodendrum var. orientalis L. Erythrina indica Lam. Erythrina orientalis (L.) Merrill Tetradapa javanorum Osbeck.

Common name

Coral tree, Indian coral tree, tiger's-claw (English) Gatae (Samoa, Horne Islands, 'Uvea, Cook Islands) Dadap aykam (Java, Indonesia).

PHARMACOLOGY

Anti-inflammatory and analgesic

Erythrina variegate has various benefits and activities for treatment, one of the treatments that has been tested as anti-inflammatory. Erythrina variegate ethanol extract at a dose of 200 and 400 mg / Kg BB showed anti-inflammatory activity for acute and chronic infections [4]. The analgesic and anti - inflammatory leaf extracts *Erythrina Variegata* with using extracts of water, ethanol and ethyl acetate from the leaves of E.Variegata. The anti -inflammatory activity of Erythrina leave water extract has been effectively tested as anti - inflammatory in albino rat-induced edema of the limbs induced by carrageenan. *E.variegata* plant extract also produces thermal induced analgesic effects. E. variegata contains steroids, triterpenoids, falvanoids, furans, alkaloids, tannins, phenols and saponins. Alkaloid compounds extracted from leaves E. Variegata have anti-inflammatory and analgesic activity [5].

Antidiabetic

Diabetic rats induced by streptozotocin. The water extract from E. Variegata was given a range of 400 mg / kg body weight for 30 days. Diabetic rats showed elevated levels of glucose and glycosylated hemoglobin (HbA1c) and decreased levels of insulin and hemoglobin. *E.variegata* water extract showed decreased blood glucose and HbA1c in diabetic rats and increased insulin and Hb levels. The Researchers have shown that *E.variegata* water extract contains hypoglycemic effects [6]. The Research conducted by Arvind Kumar, Sutharson Lingadurai, Tarani P. Shrivastava, Sanjib Bhattacharya, and Pallab K. Haldar to evaluate hypoglycemic activity leaves methanol extract of *Erythrina Variegata* in wistar rats diabetic streptozotocin. *E.variegata* leaves methanol extract was given orally and blood sugar levels decreased, thus indicating that *E.variegata* leaves are effective for antidiabetic [7].

Anti-Depressant Activity

110 medicinal plants based on phytochemical tests have been shown to have antidepressant activity from various plant parts such as roots, stems, leaves, fruit flowers or all parts of plants. Phytochemical compounds that show antidepressant activity are flavonoids, steroids, saponins, lectins and alkaloids [8]. The research conducted by Karthikeyan R and Koushik in evaluating cardiac activity of *Erythrina Variegata* depressant extract in experimental animals. Adrenaline (1 µg / ml), Calcium chloride (5 µg / ml), Acetyl choline (1 µg / ml) and Potassium chloride (5 µg / ml) were administered as standard drugs and *Erythrina Variegata* was administered at the different concentrations (10 µg / ml, 20 µg / ml). The results obtained show that *Erythrina Variegata* extract has no activity in the cardiac muscle [9].

Anticonvulsants

The treatment of epilepsy can cause dependence so that the researchers looked for natural resources that are *Erythrina Variegata* and *Butea monosperm* are traditional medicinal plants commonly used to treat seizures. Anticonvulsant activity by *Erythrina Variegata* and *Butea monosperm* of leather and leaves are then given to wistar rats which have induced seizures showed that etryol extract of Erythrina variegate and *Butea monosperm* have anticonvulsant effect [10].

Antiosteoporosis

The rats were fed a phyto estrogen-free diet that ovariectomized, then ovariectomized rats treated with low genistein (40 mg / kg), medium genistein (200 mg / kg), high genistein (500 mg / kg) and *E.variegata* extract (1000 mg / kg). Erythrina variegate inhibits bone loss in rats due to *E.variegata* extract containing isoflavone compounds derived from genistein which can prevent osteoporosis [11].

Anti - cancer

Herbal treatment anticancer by means of extracted the leaves and seeds of *E.variegata* by using methanol and fractionation. The result that, researchers have received three compounds which compounds 1 is the steroids that was identified as active compound of β-sitosterol, the compound 2 shows the $C_{28}H_{48}O$ molecular formula based on $_1$H- and $_{13}$C -NMR data and the compound 3 shows the $C_{28}H_{44}O_3$ molecular formula based on $_1$H- and $_{13}$C -NMR data. Compound 1-3 is a steroid derivative and anticancer activity of compound 1-3 shows that the compound 3 $IC5_0$ is higher than that of compounds 1 and 2. This is because the presence of dioxo groups in compound 3 can increase the anticancer activity against T47D breast cancer cells. so the researchers managed to show that the leaves and bark of *E.variegata* stem can be used as an alternative treatment of breast cancer [12].

Antimalarial

Methanol extract of E. variegata has anti-malaria activity against Plasmodium falciparum in vitro by testing lactate dehydrogenase (LDH). Methanol extract from the of E. variegata was separated using bioassay-guide fractionation. The ethyl acetate fraction showed better activity in ecototivity against both parasitic strains with IC50 23.8 μg / mL against 3D7 and 9.3 μg / mL against K1. The structure of the compound was determined by spectroscopy and identified as isoflavonoids [13]. Erythrina variegate leave extract showed that n-hexane fraction was inactive, while the ethyl acetate fraction of *E.variegata* leaf gave IC_{50} 17 μg / ml value against P. falciparum strain 3D7 and IC_{50} 27 μg / mL against strain K1. The separation and purification of the ethyl acetate fraction obtained by the active compound 3,22,23-trihydroxyolen-12-ena in the form of colorless needle crystals. The active compound has a molecular formula $C_{30}H_{50}O_3$ with data $_1$H- and $_{13}$C-NMR, so it has a double bond equivalent value (DBE) of six. E. variegata had medium-high antimalarial activity (IC50 4.3 μg / mL) against chloroquine sensitive P. falciparum strain7 and weak antimalarial activity (IC50 24 μg / mL) against chloroquine resistant K1 strains [14].

Antibacterial

E.variegata has several isoflavonoids, such as B bidwillon, erycristagallin, eryvarin Q, eryvarin U and orientanol B isolated from E.variegata, have antibacterial activity against the strains of methicillin-resistant Straphylococcus aureus [15]. Bidwillon B can inhibit the growth of 12 Staphylococcus aureus strains at a minimum inhibitory concentration of 3.13-6.25 mg / I and the minimum bactericidal concentration for Bidwillon B is 6.25-25 mg / I. So Bidwillon B has antibacterial activity against Staphylococcus aureus [16]. The researchers identified further compounds of *E.variegata* plants and found three new isoflavonoid compounds namely, Eryvarins V, W and X from *E.variegata* root isolates potentially antibacterial to methicillin-resistant Staphylococcus aureus strains [15]. Other plants from Fabaceace family have been used in traditional medicine including antibacterial and isolation results obtained by seven compounds that have antibacterial activity, namely: erynone, wighteone, alpinum isoflavone, luteone, obovatin, erythrinassinate and isovanilin but among the seven compounds that have the most antibacterial activity height is a luteone compound [17]. In a study conducted by M. Sato, H. Tanaka, S. Fujiwara, M. Hirata, R. Yamaguchi, H. Etoh, and C. Tokuda to determine the antibacterial properties of isoflavonoid isolated from Erythrina variegate plants against bacteria, found compound derivatives isoflavonoid include the following: 3,9-dihydroxy-2,10-di (yy-dimethylallyl) -6a; 11a dehydropterocarpan (erycristagallin) has high antibacterial activity against bacterial streptococci and lactobacillus bacteria with a minimum range of inhibitory concentrations of 1.56-6.25 μg / ml, and 3,6-dihydroxy-9-methoxy-2,10-in (yy- dimethylally) pterocarpan (erystagalin A) and 9-hydroxy-3-methoxy-2-y, dimethylallyl petrocarpan (orientanol B) have antibacterial effects against streptococcal bacteria. So it can be concluded that erycristagallin has the potential to prevent dental caries by inhibiting bacterial growth [18]

Antioxidants

The researchers have shown that plant-derived polysaccharides have effective antioxidant activity to counteract free radicals. One of them is by utilizing the proven *Erythrina Variegata* plant can be used as antibacterial, anti-inflammatory, antipyretic and antiseptic. *Erythrina Variegata* contains chemical compounds such as isoflavonoid, alkaloids, triterpenoids, lectins and phenols. The researchers extracted polysaccharides from *Erythrina Variegata* bark by using surface response methodology. The results showed that *Erythrina Variegata* contained mannose, rhamnose, galacturonic acid, glucose, galactose and arabinose. *Erythrina Variegata* has a strong activity against DPPH radicals so that Erythrina can be used as a natural antioxidant [19]. Antioxidant activity can be tested using High speed counter-current chromatography (HSCCC) method. Based on research conducted by Qi Liu, Jingang Yu, Xiaoyun Liao, Peisen Zhang and Xiaoqing Chen1, two new compounds that are potential in preventing DPPH free radical that is protocatechuic acid and chlorogenic acid obtained from fraction of ethyl acetate on *Erythrina Variegata* bark [20].

Toxicity

The *Erythrina Variegata* plant was used as a traditional treatment by Indonesian people and has been tested for acute toxicity of *E.variegata* leaves methanol extract showing that *E.variegata* plants are practically non-toxic. Research conducted by Herlina et al in subcritical toxicity testing of methanol extract of leaves of *E.variegata* on male wistar rats by procedure was based on OECF 408 and EPA OPPTS 870.3100 for 90 days with the dosage used 250, 500 and 1000 mg / kg BW. Methanol extract of leaves of *E.variegata* orally at doses of 250, 500 and 1000 mg / kg BW did not cause subchronic toxicity in male wistar rats [21].

Antiangiogenetic

Three anthanoids were isolated from alternaria sp. Endophytic fungi for antiangiogenic activity in the testing of rat sprouting aorta. Altersolanol compounds from isolation were characterized and showed activity in ex vivo, in vitro testing and in vivo angiogenesis on human umbilical vein endothelial cells [22].

Nutrient

The chemical composition and degradation value of three Erythrina species, Erythrina indica, Erythrina variegate and Erythrina subumbrans, have different protein content for each species. The protein content of E.indica leaves is 156 g / kg, lower than *E.variegata* and E. subumbrans, 203 and 211 g / kg. So *E.variegata* and E. subumbrans are better choices for nutrition [23]. Erythrina variegate can be used as a protein supplement to improve nutritional quality because E.variegta has a higher protein content than corn stover [24].

Anti – Alopecia

The researchers have tested several plants for traditional alopecia treatment. One of the plants that has been proven to test alopecia is pumpkin seed oil which has been shown to inhibit 5-alpha reductase and contain antiandrogenic. A randomized, placebo-controlled, double-blind study was designed to investigate the efficacy and tolerability of PSO for the treatment of alopecia in male-male patients with mild to moderate androgenic alopecia. More than 40% in patients released by PSO within 24 weeks, while for placebo only 10% [25]. Other plants that have been shown to be beneficial as a treatment for alopecia are *Erythrina Variegata* plants. The results of phytochemical screening showed ethanol extract containing tannin compounds, polyphenols, steroids, triterpenoids, quinones, monoterpenoids, and sesquiterpenoids. Ethanol and water extract extracts with concentrations of 20%, 15% and 10% can significantly nourish hair for 18 days. But the ethanol extract with levels above 10% showed better results on hair growth, while the 10% water fraction showed the best results for rabbit growth. So that the ethanol extract and the water fraction with a concentration of 10% in the *Erythrina Variegata* plant are effective for hair growth in male rabbits [26].

PHYTOCHEMISTRY

Erythrina Variegata contains steroids, triterpenoids, falvanoids, furans, alkaloids, tannins, phenols and saponins. proptocatechuic acid, chlorogenic acid and caffeic acid [1]. *E.variegata* has several isoflavonoids, such as B bidwillon, erycristagallin, eryvarin Q, eryvarin U and orientanol B, Eryvarins V, W and X, genistein [15]. The steroid derivative is β-sitosterol. 1-tricosanol, α-D-glucopyranosyl, 1 - hexatetracontanol, 1- octanyloxy - O - β - D - glucopyranosyl - O - β -Dllucopyranoside, n-dodecanyl stearate, triarachidine, stigmast - 5, 23 - dien-3β -ol 23-epistigmasterol, n-undecanyl, n-docosanoate nundecanyl, ehenate, and n-tetracont - 17-enoic acid [27]. 3-eicosyne; 3,7,11,15-tetramethyl-2-hexadecent-1-ol; butanoic acid, 3-methyl-3,7-dimethyl-6-octenyl ester; fitol; 1,2 - benzilticarboxylic acid, diundecyl ester; 1-octanol, 2-butyl; squalene; and 2H-pyran, 2- (7-heptadecynyloxy) tetrahydro-derivatives; 3,22,23-trihydroxyolen-12-ena [28]. 3- (2,4-dihydroxyphenoxy) -7-hydroxy-6,8-di (3,3-dimethylallyl) and 3-(2,4-dihydroxyphenoxy) -8 - (3,3-dimethylallyl) -2,2-dimethylpyrano [29]. The extract from E. Variegata root obtained three new compounds identified as Auriculatin, Erystagallin and Phaseollin. Amino acid analysis of the fractions isolated was 17 amino acids and the total protein isolate results consisted of twelve bands, eight for globulin and Nine for glutelin [30].

CONCLUSION

Erythrina Variegata has been used for the treatment of various diseases traditionally as the author has illustrated in this article. In addition, many studies have proven that *E.variegata* is effective in treating diseases in animal testing. Compounds such as Alkaloids, steroids and flavonoids isolated from these plants have been pharmacologically proven. The authors have not found a compound whose activity against anti - alopecia but here the authors hypothesize that an effective compound as anti - alopecia is a class of steroids that can block the enzyme 5-alpha reductase and further research is needed to identify the steroid-derived classes that have activity against anti-alopecia.

REFERENCES

1. Vanlalremkimi, Lalnundanga J, Khanduri V and Kewat S. Phenological Patterns of *Erythrina Variegata* and Erythrina Subumbrans in Two Distinct Precipitation Regime in Tropical Forests of Mizoram, Ne-India. International Journal of Agriculture Sciences. 2016; 8: 1736-1740.
2. Yusuf U.K. Erythrina subumbrans (Hassk.) Merr. In: Faridah Hanum, I & van der Maesen, L.J.G, editors. Plant Resources of South-East Asia No. 11. Auxiliary Plants. Prosea Foundation, Bogor, Indonesia; 1997. p. 126-128.
3. Stefani Tjiphanata, Edwin De Queljoe and Sri Sudewi. Pengaruh Pemberian Ekstrak Etanol Daun Dadap Ayam (Erythrina variegate L) Terhadap Kualitas Spermatozoa Tikus Putih Jantan Galur Wistar (Rattus Norvegicus). Pharmacon Jurnal Ilmiah Farmasi. 2017; 6: 2302-2493.
4. Krishna Raju Mantena V.R and Tejaswini G. Anti - Inflammatory Activity of *Erythrina Variegata*. International Journal of Pharmacy and Pharmaceutical Sciences. 2015; 4: 386-388.
5. Murugalakshmi M, Mari S and Thangapandian V. Analgesic and Anti-Inflammatory Activities of *Erythrina Variegata* Leaves Extracts. J. of Advanced Botany and Zoology. 2014; 2: 2348 – 7313.
6. Devaki K, Priyanga S and Hemmalakshmi S. Antidiabetic activity of aqueous extract of *Erythrina Variegata* L.bark in streptozotocin induced diabetic rats. Journal of Chemical and Pharmaceutical Research. 2016; 8: 306-312.
7. Kumar Arvind, Lingadurai Sutharson, Shrivastava Tarani P, Bhattacharya Sanjib, Haldar and Pallab K. Hypoglycemic activity of *Erythrina Variegata* leaf in streptozotocin induced diabetic rats. Pharmaceutical Biology. 2011; 49: 577–582.
8. Martins Jeanette and Brijesh S. Phytochemistry and pharmacology of anti – depressant medicinal plants: A review. Biomedicine & Pharmacotherapy. 2018; 104: 343-365.
9. Karthikeyan R and Koushik OS. Cardiac Depressant Activity of *Erythrina Variegata* Linn on Isolated Frog Heart. J Pharmacogn Nat Prod. 2015; 1: 107.
10. PT Sangale, DB Deshmukh and R Bhambere. Anticonvulsant Effect of Leaf and Bark of *Erythrina Variegata* Linn and Butea Monosperma (LAM) Taub in different Experimental Convulsion Model in Rats. PharmaTutor. 2015; 3: 19-23.
11. Zhang Yan, Li Qi, Li Xiaoli, Wan Hoi-Ying and Wong Man-Sau. *Erythrina Variegata* extract exerts osteoprotective effects by suppression of the process of bone resorption. British Journal of Nutrition. 2010; 104: 965– 971.
12. Herlina Tati, Julaeha Euis, Nurlelasari, Kurnia Dikdik and Supratman Unang. Potential of Dadap Ayam (*Erythrina Variegata*) Plant as Herbal Medicine. Jurnal Medika Planta. 2011; 1: 40-48.
13. Herlina Tati, Supratman Unang, Ukun M.S. Soedjanaatmadja, Subarnas Anas, Sutardjo Supriyatna, Abdullah Noor Rain and Hayashi Hideo. Indonesian Jounal of Chemistry. 2009; 2: 308 – 311.
14. Herlina Tati, Supratman Unang, Urbanas Anas, Sutardjo Supriyatna, Abdullah Noor Rain and Hayashi Hideo. Triterpenoid Pentacyclic Antimalarial Activity from the Leaves of Erythrina variegate. Jurnal Ilmu Dasar. 2011; 12: 161 – 166.
15. Tanaka Hitoshi, Atsumia Ikunori, Shirotab Osamu, Sekitab Setsuko, Sakaic Eiji, Satod Masaru, Muratae Jin, Murataf Hiroko, Darnaedig Dedy and Chenh Ih-Sheng. Three New Constituents from the Roots of *Erythrina Variegata* and Their Antibacterial Activity against Methicillin-Resistant Staphylococcus aureus. Chemistry & Biodiversity. (2011); 8: 476-482.
16. Sato Masaru, Tanaka Hitoshi, Yamaguchi Ryozo, Kato Kuniki and Etoh Hideo. International Journal of Antimicrobial Agents. 2004; 24: 43-48.
17. Akter Kaisarun, Emma Barnes C, Wendy L, Loa-Kum-Cheung, Ping Yin, Kichu Meyanungsang, Joseph Brophy J, Barrow Russell A, Imchen Imchawati, Vemulpad Subramanyam R and Jamie Joanne F. Journal of Ethnopharmacology. 2016; 185: 171-181.
18. Sato M, Tanaka H, Fujiwara S, Hirata M, Yamaguchi R, Etoh H and Tokuda C. Antibacterial property of isoflavonoids isolated from *Erythrina Variegata* against cariogenic oral bacteria. Phytomedicine. 2003; 10: 427- 433.
19. Zhang Chao, Zhou Yuanming, Sun Zhenling, Feng Jing and Wang Yingzi. Polysaccharides extraction from Erythirna variegata, chemicalcharacterization and its antioxidant activity. International Journal of Biological Macromolecules. 2014; 68: 267- 273.
20. Liu Qi, Yu Jingang, Liao Xiaoyun, Zhang Peisen and Chen Xiaoqing. One-Step Separation of Antioxidant Compounds from *Erythrina Variegata* by High Speed Counter-Current

Chromatography. Journal of Chromatographic Science. 2015; 53: 730–735.
21. Herlina Tati, Madihah, Deni deden and Amien Suseno. Subchronic Toxicity of Methanol Extract From *Erythrina Variegata* Leaves on Male Wistar Rats. Molekul. 2017; 12: 88-98.
22. Pompeng Phunlap, Sommit Damrong, Sriubolmas Nongluksna, Ngamrojanavanich Nattaya, Matsubara Kiminori and Pudhom Khanitha. Antiangiogenetic Effects of Anthranoids from Alternaria sp., an Endophytic Fungus in a Thai Medicinal Plant *Erythrina Variegata*. Phytomedicine. 2013; 20: 918-922.
23. Kongmanila Daovy, Bertilsson Jan, Ledin Inger, Yuangklang Chalermpon and Wredle Ewa. Degradability of Leaves from Three Erythrina Species in Lao PDR. Livestock Science. 2013; 155: 273-276.
24. Aregheore E M and Perera D. Effects of *Erythrina Variegata*, Gliricidia Sepium and Leucaena Leucocephala on Dry Matter Intake and Nutrient Digestibility of Maize Stover, Before and After Spraying With Molasses. Animal Feed Science and Technology. 2004; 111: 191-201.
25. Young Hye Cho, Sang Yeoup Lee, Dong Wook Jeong, Eun Jung Choi, Yun Jin Kim, Jeong Gyu Lee, Yu Hyeon Yi and Hyeong Soon Cha. Effect of Pumpkin Seed Oil on Hair Growth in Men with Androgenetic Alopecia: A Randomized, Double – Blind, Placebo – controlled Trial. Evidence-Based Complementary and Alternative Medicine. 2014; page : 1-7
26. Mustarichie Resmi, Wicaksono Imam Adi and Gozali Dolih. Anti-Alopecia Activity of DADAP (*Erythrina Variegata* L.) Leaves Ethanol Extract. Sci. & Res. 2017; 9: 1849-1854.
27. Shahnaz Sultana, Mohammed Ali and Showlat Rassol Mir. Chemical consistituents from the leaves of Adenanthera pavonina and Erythrina variegate and roots of Heliotropium eichwaldii. International Journal of Advances in Pharmacy Medicine and Bioallied Sciences. 2017; 5: 217-224.
28. Muthukrishnan Suriyavathana, Palanisamy Subha, Subramanian Senthilkumar, Selvaraj Sumathi, Maril Kavitha Rani and Kuppulingam Ramalingam. Phytochemical Profile of *Erythrina Variegata* by Using High-Performance Liquid Chromatography and Gas Chromatography-Mass Spectroscopy Analyses. Journal of Acupuncture and Meridian Studies. 2016; 9: 207-212.
29. Tanaka Hitoshi, Hirata Miyuki, Etohb Hideo, Shimizuc Hiroshi, Sakod Magoichi, Muratae Jin, Murataf Hiroko, Darnaedig Dedy and Fukaih Toshio. Eryvarins F and G, two 3-phenoxychromones from the roots of Erythrina variegate, Phytochemistry. 2003; 62: 1243–1246.
30. Titil Datta Samanta and Subrata Laskar. Chemical Inverstigation of *Erythrina Variegata* Linn Seed Proteins. Food Chemisty. 2009; 114: 212-216.