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Prevalence and Associated Factors of Anemia in Different Periods of Pregnancy

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ABSTRACT

Objectives: This study aimed to study the prevalence of anemia in the different period of pregnancy and also indicated precipitating factors that caused failure of anemia prophylaxis in antenatal care.

Materials and Methods: This was a longitudinal prospective study enrolled total 130 pregnant women who visit antenatal care (ANC) clinic from November 2020 to August 2021. A questionnaire was completed during the third trimester and complete blood count was evaluated at each period of pregnancy: in first ANC, during third trimester and intrapartum period. All data were analyzed by SPSS software (version 22.0).

Results: The prevalence of anemia in first ANC, third trimester and intra-partum was 6.92%, 24.62%, and 4.76% respectively. Poor compliance of iron supplementation and clinical morning sickness were associated with anemia in the third trimester of pregnancy.

Conclusion: Anemia in pregnancy remains an urgent public health problem in Thailand. Strict compliance with iron supplementation is vital for preventing anemia in pregnancy.

Keywords: anemia, pregnancy, iron supplementation, morning sickness, compliance, education.

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ความชุกและปัจจัยที่เกี่ยวข้อง ของภาวะโลหิตจางในแต่ละช่วงเวลาของการตั้งครรภ์

สุภเวช เลิศประสบสุข, บุษบา วิริยะสิริเวช

บทคัดย่อ

วัตถุประสงค์: *ภาวะโลหิตจางขณะตั้งครรภ์เป็นปัญหาทางด้านสาธารณสุขที่พบบ่อยในประเทศไทย วัตถุประสงค์ของงานวิจัยชิ้นนี้ คือ เพื่อศึกษาความชุกของภาวะโลหิตจางในระยะต่างๆ ของการตั้งครรภ์ และหาปัจจัยที่ทำให้การป้องกันภาวะโลหิตจางระหว่างการฝากครรภ์ล้มเหลว*

วัสดุและวิธีการ: *เป็นการศึกษาเชิงพรรณนา (แบบไปข้างหน้า) โดยผู้เข้าร่วมการวิจัยคือ สตรีตั้งครรภ์จำนวน 130 คน ที่มาฝากครรภ์ที่คลินิกฝากครรภ์ ของโรงพยาบาลวชิรพยาบาล ตั้งแต่ เดือนพฤศจิกายน พ.ศ.2563 ถึง เดือนสิงหาคม พ.ศ.2564 ผู้เข้าร่วมการวิจัยแต่ละคนจะต้องตอบแบบสอบถามในช่วงไตรมาสที่สามของการตั้งครรภ์ และได้รับการตรวจเลือด CBC (complete blood count) ตั้งแต่การฝากครรภ์ครั้งแรก, ระหว่างไตรมาสที่สามของการตั้งครรภ์ และระหว่างช่วงการคลอดตามลำดับ*

ผลการศึกษา: *ความชุกของภาวะโลหิตจางในช่วงการฝากครรภ์ครั้งแรก, ช่วงไตรมาสที่สามของการตั้งครรภ์ และช่วงระหว่างการคลอดที่ห้องคลอด คือ ร้อยละ 6.92, 24.62 และ 4.76 ตามลำดับ โดยที่ปัจจัยที่เกี่ยวข้องกับภาวะโลหิตจางในไตรมาสที่สามของการตั้งครรภ์อย่างมีนัยสำคัญคือ มีภาวะแพ้ท้องในช่วงไตรมาสแรกของการตั้งครรภ์ และไม่มีความสม่ำเสมอในการรับประทานธาตุเหล็กเสริมระหว่างตั้งครรภ์*

สรุป: *แม้ว่าความชุกของภาวะโลหิตจางในหญิงตั้งครรภ์ในกรุงเทพมหานครมีแนวโน้มลดลง แต่ก็ยังคงเป็นปัญหาทางสาธารณสุขที่สำคัญของประเทศไทย การรับประทานธาตุเหล็กเสริมตามที่แพทย์สั่งอย่างเคร่งครัด ช่วยลดโอกาสการเกิดภาวะโลหิตจางลงได้*

คำสำคัญ: *ภาวะโลหิตจาง, หญิงตั้งครรภ์, ธาตุเหล็กเสริม, ภาวะแพ้ท้อง, ความสม่ำเสมอในการรับประทานธาตุเหล็กเสริมระหว่างตั้งครรภ์*

Introduction

According to World Health Organization (WHO) criteria[1], anemia in pregnancy is defined as a blood hemoglobin level of below 11.0, 10.5, and 11.0 g/dL in the first, second, and third trimester, respectively. There are many causes of anemia. The first one is dilutional anemia, which occurs when the increase of blood plasma volume is greater than hemoglobin, causing hemoglobin level to decrease proportionally compared with non-pregnant women[2]. The second one is iron deficiency anemia. The prevalence of iron deficiency increases during pregnancy as women need a higher amount of iron after mid pregnancy. In addition, the patient may have an underlying condition that causes anemia, such as chronic renal disease and thalassemia. Anemia can affect both pregnant women and infants[3]. Hemoglobin transports oxygen throughout the body, as well as to the placenta. WHO reports that anemia increases maternal mortality rate, maternal sepsis, cesarean section rate, and blood transfusion rate. There is also an elevated risk of low birth weight and preterm birth in the fetus affected[4].

Nowadays, anemia in pregnancy is a global health problem, especially in developing countries. The WHO estimates that 40% of pregnant women are anemic. The prevalence of anemia in some areas of Thailand is estimated at 50% despite the efforts by health care workers to provide iron and folic acid supplements among pregnant women. With exception of iron deficiency, hemoglobinopathy, dilutional anemia, and other chronic diseases, anemia can also caused by other precipitating factors such as lifestyle, education, income per month, and duration of and compliance with iron supplement intake during pregnancy. Failure of anemia prophylaxis arises from these factors.

Cuneyt et al[5] reported that the prevalence of anemia in term pregnant women in Turkey was 41.6%, with the associated factors being parity, literacy, income per month, duration of iron supplement intake, and history of preeclampsia. In India, Suryanarayana et al[6] reported that the prevalence was 62.3%. Literacy was also an important factor. These reports demonstrated that anemia could cause fetal low birth weight, preterm birth and pregnancy induced hypertension significantly. Although there are several studies in Thailand which report the prevalence of anemia in pregnancy, the data on factors associated with anemia is still limited. These studies focus on the overall data of anemic pregnant women which do not exclude the data on those with thalassemia and anemia due to chronic disease. Siriwong et al[7] reported that the prevalence of anemia in pregnant women who visited the antenatal clinic in Mae-sot hospital was 49%. In 2003, Chotnopparatpattara et al[8] reported that the prevalence of anemia in pregnant women who visited the antenatal clinic in Chulalongkorn hospital was 14.8%, 20.5%, and 38.6% in the first, second and third trimester, respectively. In 2016, The Ministry of Public Health launched Thailand's antenatal care guidelines for health care workers[9] that provided a standard dose of iron supplements. Pregnant women thoroughly received iron supplementation to prevent anemia, but we have never reevaluated the prevalence of anemia again.

This research aimed to study the prevalence of anemia in the different periods of healthy pregnant women who received standard iron supplement program and indicated precipitating factors that cause the failure of anemia prophylaxis in the third trimester because the highest prevalence of anemia was found in the third trimester of pregnancy, the period of which we had sufficient time to correct an anemia before labor.

Materials and Methods

A longitudinal prospective study was carried out at the antenatal clinic, the Faculty of Medicine Vajira Hospital, Navamindradhiraj University, a tertiary-care university hospital. The study was conducted in accordance with the ethical principles of the declaration of Helsinki, and the study protocol was approved by the Vajira Institutional Review Board. Informed consents were obtained from all subjects.

Study design and participants

This study recruited healthy singleton pregnant women in the third trimester of pregnancy who attended services at the antenatal clinic of Vajira Hospital, Bangkok, Thailand. In order to exclude any factors interfering with anemia results, the pregnant women enrolled in this study had to have a normal thalassemia screening result without any chronic disease.

The inclusion criteria were as follows: age over 18 years old, singleton pregnancy, gestational age more than 28 weeks, attending the antenatal clinic at Vajira Hospital, having evaluated with complete blood count before gestational age (GA) 20 weeks, having attended for the first antenatal care before GA 20 weeks, and having negative deichorophenol precipitation test (DCIP) result with an mean corpuscular volume (MCV) of more than 80 fl. The exclusion criteria were those with a chronic disease that can cause anemia, such as chronic kidney disease, autoimmune disease, HIV infection, etc.

All participants were provided with information explaining the objectives of the study before signing consent forms at the antenatal clinic. Then, the participants completed the questionnaire forms given to them. The questionnaire collected participants' information from the first trimester to the third trimester. Health care workers were ready to answer the participants any questions related to the questionnaire while the questionnaire was being completed. The complete blood count of each participant in the third trimester was collected at this visit and was collected again before labor. The complete blood count in the first ANC and related information were collected by the E-phis system of Vajira Hospital.

Outcome measures

Blood samples were collected from all pregnant women on the first day that they attended the ANC, during the third trimester, and during the intrapartum period, respectively. Gestational age was estimated using the date of last menstruation and the ultrasound scan measurements. The medical and obstetrical history (gravid, underlying disease, history of anemia, history of blood transfusion, and iron supplement), socioeconomic data, and demographic data were collected from the participants' information forms. Each participant's weight and height were measured in kilograms and centimeters, respectively. Then, each participant completed a self-questionnaire which consisted of questions related to the information nationality, history of morning sickness, compliance to iron supplementation, income per month, educational level, and their antenatal clinic appointment attendance.

Statistical analysis

The sample size was calculated using the formula for descriptive study. When the prevalence of anemia in the third trimester was 38.6%, and the level of significance (α) = 0.05 and d = 0.09, one hundred and twenty participants were required.

All data were analyzed by SPSS software (version 22.0). The data were presented as mean ± standard deviation (SD), number (%), or percentage (95% confidence interval (CI)) as appropriate. The quantitative measures are presented by mean and SD and qualitative variables by proportions. A comparison of the risk factors between anemic and non-anemic groups of pregnant women in the third trimester was performed using Chi-square statistics, with a p value less than 0.05 being considered statistically significant. The odds ratio (OR) with 95%CI was used to measure the strength of association between anemia and exposure variables.

The categorization of variables was as follow: (1) a pregnant woman was considered anemic if the hemoglobin level was < 11 g/dl, (2) the monthly income is categorized into 2 groups: < 10,000 bath and > 10,000 bath, (3) the maternal age was categorized into 2 groups: < 35 years old and ≥ 35 years old (based on the age of elderly primigravida mother)[10], (4) BMI (body mass index) was categorized into 4 groups: underweight, normal,

overweight, and obese, (5) the interpregnancy interval was categorized into 2 groups: < 5 years and ≥ 5 years (according to the report of a WHO technical consultation on birth spacing)[11], (6) the gestational age at the first antenatal care visit was categorized into 2 groups: ≤ 12 weeks and > 12 weeks (entering ANC after 12 weeks of gestation was considered late)[12, 13], (7) the gestational age at the initial stage of iron supplementation was categorized into 2 groups: ≤ 12 weeks and > 12 weeks (based on the recommendation by the Centers for Disease Control and Prevention (CDC) that iron supplementation should be initiated at the first antenatal visit)[14], (8) the weight gain in third trimester was categorized into 3 groups: <10 kg, 10-15 kg, and >15 kg (based on the recommendation for total and rate of weight gain during pregnancy)[10]. The compliance of iron supplementation was categorized in 2 groups: good compliance (> 80%) and poor compliance (< 80%).

Results

The demographic data of the participants were as follows. The participant's age (the total number of participants is 130) ranges from 18 to 42 years, with a mean age of 28.59 (SD 6.21) years. The majority of the participants (114 participants) were Thai (87.6%), 81 were multigravida (62%), 69 had normal weight (53%), 70 were secondary school graduated (53%), and 68 had a monthly income of 10,000 - 20,000 bath (52.3%). Fifty-two percent of multigravida reported an interpregnancy interval of more than 5 years. 85.4% of participants reported that they had received iron supplements at GA between 12-20 weeks, 63% reported that they had their first visit at the antenatal care clinic at GA before 12 weeks, and 84% had good compliance with iron supplements.

The prevalence of anemia in the first ANC, the third trimester, and the intrapartum period was 6.92%, 24.62% and 4.76%, respectively, as demonstrated in Table 1.

Table 1. Prevalence of anemia by period of pregnancy.

Period of pregnancy	n (%)	Hb mean ± SD (range)	Hct mean ± SD (range)
First ANC (n = 130)	9/130 (6.9%)	10.24 ± 0.33 (9.7 - 10.7)	31.74 ± 1.50 (28.5 - 33.1)
Third trimester (n = 130)	32/130 (24.6%)	10.58 ± 0.36 (9.5 - 10.9)	32.23 ± 1.21 (29.0 - 34.0)
Intrapartum (n = 94)	4/94 (4.3%)	10.35 ± 0.33 (10.1 - 10.8)	31.07 ± 0.93 (29.8 - 31.9)

ANC: antenatal care, Hb: hemoglobin, Hct: hematocrit, SD: standard deviation

Regarding the factors associated with anemia in Pregnancy, Table 2 demonstrates the associations between anemia in the third trimester and several predictor variables. Pregnant women who had poor compliance for iron supplements had six times higher odds of being anemic (OR 6.75, 95%CI 2.44-18.67) compared to pregnant women who had good compliance. Pregnant women who used to have morning sickness in the first trimester had 2.5 times higher odd of being anemic (OR 2.59, 95%CI 1.11-6.04) compared to pregnant women who never had morning sickness. Other factors including race, income per month, education, age, gravida, body mass index (BMI), inter-pregnancy interval, and GA at the first ANC were assessed, but they were not associated with anemia during the third pregnancy.

Table 2. Univariable analysis for factors associated with anemia in the third trimester of pregnancy.

Factors	Anemia Hb < 11 g/dL (n = 32)		No anemia Hb > 11 g/dL (n = 98)		OR	95%CI	p value
	n	(%)	n	(%)			
Race							
Thai	30	(93.8)	84	(85.7)	2.50	(0.54 - 11.65)	0.243
Other	2	(6.3)	14	(14.3)	1.00	Reference	
income							
< 10000 bath	11	(34.4)	43	(43.9)	1.00	Reference	
> 10000 bath	21	(65.6)	55	(56.1)	1.49	(0.65 - 3.43)	0.345
Education							
Secondary school or below	24	(75.0)	66	(67.3)	1.46	(0.59 - 3.59)	0.417
College school	8	(25.0)	32	(32.7)	1.00	Reference	
Age							
< 35 years old	25	(78.1)	81	(82.7)	1.00	Reference	
≥ 35 years old	7	(21.9)	17	(17.3)	1.33	(0.50 - 3.58)	0.567
Gravida							
Primigravidarum	13	(40.6)	36	(36.7)	1.18	(0.52 - 2.67)	0.694
Multigravida	19	(59.4)	62	(63.3)	1.00	Reference	
BMI							
Under weight	4	(12.5)	15	(15.3)	0.67	(0.19 - 2.36)	0.530
Normal range	14	(43.8)	35	(35.7)	1.00	Reference	
Overweight	6	(18.8)	14	(14.3)	1.07	(0.34 - 3.35)	0.906
Obese	8	(25.0)	34	(34.7)	0.59	(0.22 - 1.58)	0.293
Pregnancy interval							
< 5 years	9	(28.1)	25	(25.5)	1.35	(0.45 - 4.02)	0.590
> 5 years	8	(25.0)	30	(30.6)	1.00	Reference	
Unknown	15	(46.9)	43	(43.9)	1.31	(0.49 - 3.47)	0.590
GA at the first ANC							
< 12 weeks	19	(59.4)	64	(65.3)	1.00	Reference	
> 12 weeks	13	(40.6)	34	(34.7)	1.29	(0.57 - 2.92)	0.545
GA when first received iron supplements							
< 12 weeks	1	(3.1)	12	(12.2)	1.00	Reference	
> 12 weeks	31	(96.9)	86	(87.8)	4.33	(0.54 - 34.66)	0.168
Missing an appointment							
Never	29	(90.6)	90	(91.8)	1.00	Reference	
1 time	3	(9.4)	8	(8.2)	1.16	(0.29 - 4.68)	0.831
Morning sickness							
No	10	(31.3)	53	(54.1)	1.00	Reference	
Yes	22	(68.8)	45	(45.9)	2.59	(1.11 - 6.04)	0.027
Compliance with iron supplementation							
> 80%	20	(62.5)	90	(91.8)	1.00	Reference	
< 80%	12	(37.5)	8	(8.2)	6.75	(2.44 - 18.67)	< 0.001

Hb: hemoglobin, OR: odds ratio, CI: confidence interval, BMI: body mass index, GA: gestational age.

Discussion

The prevalence of anemia in third trimester pregnant women in this study was 24.6%. Other studies[7, 8, 15-17] reported that the prevalence of anemia in the third trimester of pregnancy was between 38.6% - 50%. Concerning the period of pregnancy, according to this study, the highest prevalence of anemia was among pregnant women in the third trimester and other studies[8, 15-17] also reported similar findings. However, in this study, the prevalence of anemia during the intrapartum period was much lower compared to that of the third trimester period. We suggested further study to explain the improvement of anemic status during the intrapartum period.

Pregnant women tended to be anemic more than non-pregnant women due to physiological change (dilutional effect) and increased iron consumption. Sukrat et al[17] demonstrated that the main causes of anemia during pregnancy were thalassemia carriers/ disease (54.9%) and iron deficiency (43.1%). Over the past year, the government has reinforced ANC service, leading to pregnant women thoroughly receiving iron supplementation to prevent anemia. However, the prevalence of anemia in Thailand is still high, which means that there are precipitating factors that have caused the failure of anemia prophylaxis in antenatal care. Several studies[5, 6, 18] reported that education and literacy were associated with anemia. Patients with higher education had less tendency to develop anemia than those without one. Taner et al[5] reported that the associated factors with anemia were parity, income per month, duration of iron supplementation, and the number of times visiting ANC. Siriwong et al[7] reported that nationality was associated with anemia. The prevalence of anemia in Burmese pregnant women was higher than in Thai pregnant women.

In this study, we found that compliance with iron supplementation and morning sickness were associated with anemia. Pregnant women who had good compliance with iron supplementation and didn't have clinical morning sickness were less likely to be anemic compared to their counterparts. Compliance with iron supplementation and morning sickness were closely relevant. Pregnant women who had nausea and vomiting also encountered poor drug compliance. Nasir et al[19] reported that forgetfulness and fear of side effects were the commonest reasons for poor adherence to IFAS (iron and folic acid supplementation) in Ethiopia. Fouelifack et al[20] reported that the reasons for non-adherence were side effects, forgetfulness, and inaccessibility of iron supplements in Cameroon. Kiwanuka et al[21] reported that inadequate drug supplies and fear of side effects were the main reasons why participants had not taken iron supplements in Uganda. As mentioned previously, poor compliance with iron supplementation arises not only because of patient behavior, but also from factors out of the patient's control. In Thailand, there was insufficient data exploring the causes of poor drug compliance.

Strict compliance with iron supplementation is believed to be vital for preventing anemia in pregnancy. Maternal misunderstanding about the iron supplement program should be corrected. Pregnant women should have awareness about anemia in pregnancy and the benefits of iron supplements. Sirisopa et al[22] reported that the pharmaceutical care program for pregnant women with iron deficiency anemia can play a role in the improvement of the iron deficiency status of Thai pregnant women. Health care providers must renew their commitment to iron therapy by monitoring and improving compliance.

Regarding the strength and weakness of this study, pregnant women who were enrolled in this study had a normal thalassemia screening result and didn't have any chronic disease that interfered with the anemic result. However, the sample size was too small to effectively analyze associated factors with anemia.

Conclusion

Anemia in pregnancy was a public health problem in Thailand. Prevalence of anemia in the third trimester of pregnancy was 24.6%. Poor compliance of iron supplementation and clinical morning sickness were associated with anemia in the third trimester of pregnancy. We suggested further study to explore the causes of poor compliance with iron supplementation

in Thailand.

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Potential conflicts of interest

The authors declare no conflicts of interest.

References

1. World health organization. WHO recommendation on antenatal care for a positive pregnancy experience. Geneva: World Health Organization 2016.
2. Cunningham FG, Leveno KJ, Bloom SL, Dashe JS, Hoffman BL, Casey BM, et al. Williams Obstetrics. 25th ed. New York: McGraw-hill 2019:57-58.
3. Daru J, Zamora J, Fernández-Félix BM, Vogel J, Oladapo OT, Morisaki N, et al. Risk of maternal mortality in women with severe anaemia during pregnancy and post-partum: a multilevel analysis. Lancet Glob Health 2018;6:548-54.
4. Ren A, Wang J, Ye RW, Li S, Liu JM, Li Z. Low first-trimester hemoglobin and low birth weight, preterm birth and small for gestational age newborns. Int J Gynaecol Obstet 2007;98:124-8.
5. Taner CE, Ekin A, Solmaz U, Gezer C, Cetin B, Kelesoglu M, et al. Prevalence and risk factors of anemia among pregnant women attending a high-volume tertiary care center for delivery. J Turk Ger Gynecol Assoc 2015;6: 231-6.
6. Suryanarayana R, Chandrappa M, Santhuram AN, Prathima S, Sheela SR. Prospective study on prevalence of anemia of pregnant women and its outcome: a community based study. J Family Med Prim Care 2017;6:739-43.
7. Siriwong O. Anemia in pregnant women attending the Antenatal Care Clinic, Mae Sot Hospital. Thai J Obstet Gynaecol 2012;20:186-90.
8. Chotnopparatpattara P, Limpongsanurak S, Charnngam P. The prevalence and risk factors of anemia in pregnant women. J Med Assoc Thai 2003;86:1001-7.
9. Sayomporn S., Pisek L., Eakachai K., Attasit S. Pregnancy care guideline. 1. Bangkok: wvo officer of printing mill 2016.
10. Eleje GU, Iqwegbe AO, Okonkwo JE, Udigwe GO, Eke AC. Elderly primigravidae versus young primigravidae: a review of pregnancy outcome in a low resource setting. Niger J Med 2014;23:220-9.
11. World Health Organization. Report of a WHO technical consultation on birth spacing. Geneva: World Health Organization 2007.
12. Moller AB, Petzold M, Chou D, Say L. Early antenatal care visit: a systematic analysis of regional and global level and trends of coverage from 1990 to 2013. Lancet Glob Health 2017;5:e977-83.
13. Trinh LT, Rubin G. Late entry to antenatal care in New South Wales, Australia. Reprod Health 2006;3:8.
14. Morey SS. CDC issues guidelines for prevention, detection and treatment of iron deficiency. Am Fam Physician 1998;58:1475-7.
15. Thongperm W, Chaisen M, Chunchom Y, Aueduldecha S, Sarakul O. Preliminary study for the prevalence and causes of anemia in pregnant women attending an antenatal care unit in different periods of gestation. JAMS 2018;51:122-7.
16. Sukrat B, Suwathanapisate P, Siritawee S, Poungthong T, Phupongpankul K. The prevalence of iron deficiency anemia in pregnant women in Nakhonsawan, Thailand. J Med Assoc Thai 2010;93:765-70.
17. Sukrat B, Sirichotiyakul S. The prevalence and causes of anemia during pregnancy in Maharaj Nakorn Chiang Mai Hospital. J Med Assoc Thai 2006;89: 142-6.
18. Stephen G, Mgongo M, Hashim TH, Katanga J, Stray-Pedersen B, Msuya SE. Anaemia in pregnancy: prevalence, risk factors, and adverse perinatal outcomes in northern Tanzania. Anemia 2018;2018:1846280.
19. Nasir BB, Fentie AM, Adisu MK. Adherence to iron and folic acid supplementation and prevalence of anemia among pregnant women attending antenatal care clinic at Tikur Anbessa Specialized Hospital, Ethiopia. PLOS One 2020;15:e0232625.
20. Fouelifack FY, Sama JD, Sone CE. Assessment of adherence to iron supplementation among pregnant women in the Yaounde gyneco-obstetric and pediatric hospital. Pan Afr Med J 2019;34:211.
21. Kiwanuka TS, Ononge S, Kiondo P, Namusoke F. Adherence to iron supplements among women receiving antenatal care at Mulago National Referral Hospital, Uganda-cross-sectional study. BMC Res Notes 2017;10:510.
22. Sirisopa N, Pongchaidecha M. Evaluation of a pharmaceutical care program with pregnant women with iron deficiency anemia. J Sci Technol Ubon Ratchathani Univ 2015;2:53-62.