The Effect of Pumpkin Seeds Biscuits and Moringa Extract Supplementation on Hemoglobin, Ferritin, C-reactive protein, and Birth Outcome for Pregnant Women: A Systematic Review

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Abstract

BACKGROUND: According to the WHO data, 40% of maternal mortality in developing countries is related to anemia in pregnancy. Most anemia in pregnancy is caused by iron deficiency and acute bleeding, sometimes even the two interact. The incidence of anemia in pregnancy in Indonesia is quite high, which is around 67% of all pregnant women, with variations depending on each region. About 10–15% of pregnant women are classified as severe anemia which of course will affect the growth and development of the fetus in the womb. Most of the anemia in pregnant women occurs due to malnutrition.

AIM: The objective of the study was to review journals related to the effect of pumpkin seed biscuits and Moringa capsules on hemoglobin (Hb), ferritin, and C-reactive protein (CRP) levels in pregnant women and also the prevention of stunting.

METHODS: Study of literature by collecting relevant literature using online journal data based on PUBMED, Google Search, ELSEVIER, MDPI, DOAJ (Direct Directory of Open Access Journals), or from the bibliography of the articles being searched.

RESULTS: Supplementary food was given to pregnant women by giving pumpkin seeds and Moringa leaf extract impact on improving nutritional status, Hb, ferritin, and CRP levels in pregnant women, as well as preventing adverse pregnancy outcomes such as low birth weight.

CONCLUSION: The provision of pumpkin seed biscuits and Moringa leaf extract to pregnant women can affect Hb, ferritin, and CRP levels and can affect maternal nutritional status and affect pregnancy outcomes.

Introduction

Pregnancy is the growth and development of an intrauterine fetus from conception and ending until the onset of labor. The duration of gestation is estimated at 280 days (40 weeks) and not more than 300 days (43 weeks). According to the WHO data, 40% of maternal deaths in developing countries are related to anemia during pregnancy. Most anemia in pregnancy is caused by iron deficiency and acute bleeding, sometimes even the two interact. The incidence of anemia in pregnancy in Indonesia is quite high, which is around 67% of all pregnant women, with variations depending on each region. Iron metabolism is influenced by various factors, one of which is protein [1]. Protein has an important role in providing organic iron intake. Organic iron is obtained from food intake, especially in red meat [2], and is an important functional unit for binding iron and preventing potential toxic oxidants in the form of hemoproteins as heme compounds (hemoglobin [Hb] or myoglobin) and heme enzymes. Ferritin is an iron storage protein and is present extracellularly in serum. Ferritin serves as a clinical marker of the status of the body’s iron stores [3]. Iron deficiency anemia caused significant increase in platelet count (PT) and total iron-binding capacity (TIBC) [4].

The WHO data report that babies with low birth weight (LBW) account for 60–80% of all neonatal deaths and have a risk of death 20 times greater than babies with normal weight. The percentage of LBW in developing countries is 16.5%, twice as large as in developed countries (7%) [5]. Long-term impact of LBW is stunting. Stunting is a physical growth disorder characterized by a decrease in growth rate and is a result of nutritional imbalances. Stunting is still a nutritional problem in Indonesia that has not been resolved. Stunting will cause long-term impacts, namely, disruption of physical, mental, intellectual, and cognitive development. Children who are stunted until the age of 5 years will be difficult to repair so that it will continue into adulthood and can increase the risk of offspring with LBW [6].

Pregnant women should meet the requirement for certain nutrients, especially micronutrients to ensure
the better pregnancy outcome later on. Efforts to fulfill the nutritional status of pregnant women and babies can be fulfilled with a good source of nutrition, namely, pumpkin fruit and Moringa leaf. The pumpkin plant is a type of fruit that belongs to the Cucurbitaceae family, including seasonal plants that bear fruit immediately after death. Pumpkin seeds are a plant that is easy in the nursery, care, and the results are sufficient to provide high economic value to the community. Pumpkin seeds are widely cultivated in African countries, America, India, and China. Pumpkin seeds usually grow in low and high plains, altitudes between 0 m and 1500 m above sea level [7].

Pumpkin seeds are a plant that is easily found in Indonesia. However, the use of pumpkin seeds in the community is still minimal. Cucurbita moschata seeds contain several substances, including a type of amino acid such as m-carboxyphenylalanine, amino butyrate, and citrulline as well as a number of other amino acids needed by the prostate gland such as seminal alanine, glycine, and glutamic acid. These seeds also contain mineral elements Zn (zinc) and Mg (magnesium) which are very important for reproductive health. Pumpkin seeds are a good source of phytoestrogens and may exert weak estrogenic or anti-estrogenic effects which decrease blood pressure and reduce C-reactive protein (CRP) [8]. CRP is expressed in human atherosclerotic plaques and both vascular cells and monocytes/macrophages appear to represent a significant source of CRP in the inflammatory vessel wall [9]. Moringa oleifera leaves have long been used to overcome the problem of malnutrition among children, pregnant women, and breastfeeding. In addition, with micronutrients substances, M. oleifera can be used as an alternative supplement for pregnant women to prevent maternal anemia and LBW.

The aim of this literature review is to assess journal article related to impact supplementation of pumpkin seeds and Moringa extract on Hb, ferritin, CRP, and birth outcome for pregnant woman.

Methods

Study selection: The systematic review uses database from the PubMed, Scinapse, and ProQuest. The search criteria in the database use the word “pumpkin seeds,” “Moringa leaf,” “outcome pregnant,” growth with restrictions on articles published during the past 10 years (2010–2020), English language articles, open access. The inclusion criteria were as follows: (1) Full-text articles were selected, (2) targeting studies of mother-children (under 5 years old), and (3) randomized controlled trial study. Exclusion criteria were as follows: (1) Review/editorial, (2) conference proceedings, (3) systematic review/literature review, (4) study protocol, and (5) meta-analysis. Figure 1 shows a flowchart for study based on PRISMA 2015 guidelines.

Results and Discussion

Table 1 shows that there are 13 articles that were successfully selected related to the Effect of intervention pumpkin seeds and Moringa leaf on pregnancy outcomes published in 2008 - 2019.

**Pumpkin seeds and Moringa leaf extract**

The chemical composition and several bioactive components such as tocopherols, carotenoids, and β-sitosterol were analyzed in three main pumpkin species (Cucurbitaceae pepo, C. moschata, and Cucurbita maxima) in three parts (peeled, meat, and seeds) each of the pumpkin species. C. maxima contains more carbohydrates, protein, fat, and fiber than Cucurbita pepo or C. moschata (p < 0.05). The water content and amino acids and arginine content in all parts of the pumpkin are the highest in C. pepo. The main fatty acids in the seeds are palmitic, stearic, oleic, and linoleic acids. The seeds of C. pepo and C. moschata contain much more γ-tocopherol than C. maxima, whose seeds contain highest β-carotene. C. pepo seeds contain much more β-sitosterol than other seeds. Nutrient composition varies different between species and parts of the pumpkin [10]. Nutritional value of pumpkin seeds per 100 g included carbohydrates 10.71 g, energy 559 kcal, total fat 49.05 g, protein 30.23 g, fiber 6 g, cholesterol 0 mg, folic acid 58 µg, niacin 4.8 mg, Vitamin B5 0.75 mg, B6 0.14 mg, B2 0.15 mg, thiamin 0.272 mg, Vitamin C 0.272 mg, Vitamin A 16 IU, Vitamin E 35.1 mg, mineral sodium 7.0 mg, potassium 809.0 mg, minerals cobalt 1.43 mg, iron 8.8 mg, magnesium 592 mg, mangan 4.54 mg, phosphor 1232 mg, selenium 9.40 µg, and zinc 7.8 mg. Phytochemical dense including beta-carotenoid 9 µg, beta-cryptoxanthin 1 µg, and lutein zeaxanthin 74 µg [11].
| No. | Author/place/year | Title | Study objective | Design | Study outcome |
|-----|-------------------|-------|----------------|--------|---------------|
| 1   | Maya M/USA/2017 [8] | Dissertation: Effect of supplementation with pumpkin seed oil versus pumpkin seeds on blood pressure and menopausal symptoms in non-hypertensive postmenopausal women | To compare influences pumpkin seed oil (1 1/2 teaspoons/4.1 g daily) versus pumpkin seed oil (2 g/day) for 12 weeks on blood pressure (systolic and diastolic), endothelial function, plasma lipids, C-reactive protein concentration, and menopausal symptoms in non-hypertensive postmenopausal women | Randomized control trial | Pumpkin seeds help with weight loss and reduction in body fat percent which is most likely due to the benefits of satiety from high protein and fiber content in pumpkin seeds. Pumpkin seed oil supplementation confirmed previous findings suggest a significant reduction in diastolic blood pressure and menopause symptoms, small improvements in low-density lipoprotein and total cholesterol, and decreased C-reactive protein. |
| 2   | Naghi and Moftir Miran/2008 [27] | Impact of daily consumption of iron fortified ready-to-eat cereal and pumpkin seed kernels (Cucurbita pepo) on serum iron in adult women | This is to determine the effectiveness of consuming ready-to-eat cereals and pumpkin seed kernels on status of iron nutrition and response of hematological characteristics of women at reproductive ages | Experiment study | Better response for iron status was observed after intervention. The statistical analysis showed a significant difference between the pre and post consumption phase for higher serum iron (60 ± 22 vs. 85 ± 23 up/dl), higher transferrin saturation percent (16.8 ± 8.0 vs. 25.6 ± 9.0%), and lower total iron binding capacity (387 ± 31 vs. 339 ± 31 up/dl). A significant positive correlation (r = 0.981, p = 0.001) between the differences in serum iron levels and differences in transferrin saturation percentages and a significant negative correlation (r = −0.916, p < 0.001) between the differences in serum iron levels and differences in total iron binding capacity. |
| 3   | Resmi et al., India/2017 [16] | Effectiveness of amla, jaggery and pumpkin leaves extract on the level of hemoglobin, Vitamin C and iron among adolescent girls with iron deficiency anemia | Assessing the effectiveness of a mixture of amla, jaggery, and pumpkin leaves on hemoglobin, Vitamin C, and iron levels in adolescent girls with iron deficiency anemia | Randomized to the control and experimental group | There was significant increment in the pre-test and post-test level of hemoglobin, Vitamin C, and iron of the subjects in the experimental group. In the experimental group, there was a rise in mean values for hemoglobin from 9.942 to 10.99, Vitamin C from 4.302 to 5.63, and iron from 77.6 to 99.58 Rats fed on iron-free diet supplemented with seven iron sources revealed significant increase in hemoglobin, Hct, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, red blood cell, white blood cell, serum iron, and significant decreased in platelet count and total iron-binding capacity. Mixture of legumes, cereals, and molasses with ascorbic acid and molasses has protection against iron deficiency anemia and is equivalent to FeSO |
| 4   | Soltan SSA/Egypt/2013 [4] | The protective effect of soybean, sesame, lentils, pumpkin seeds, and molasses on iron deficiency anemia in rats | To determine the protective effect of cooked soybeans, rpe lentils, sesame seeds, pumpkin seeds, molasses, and their mixtures (soy + lentils + sesame seeds + pumpkin seed powder + molasses) with ascorbic acid against iron deficiency anemia | Randomized to the control and experimental group | Rats fed on iron-free diet supplemented with seven iron sources revealed significant increase in hemoglobin, Hct, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, red blood cell, white blood cell, serum iron, and significant decreased in platelet count and total iron-binding capacity. Mixture of legumes, cereals, and molasses with ascorbic acid and molasses has protection against iron deficiency anemia and is equivalent to FeSO |
| 5   | Abuelgassam and Al-Showayan S/A/Saudi Arabia/2012 [17] | The effect of pumpkin (Cucurbita pepo L.) seeds and L-arginine supplementation on serum lipid | To determine the effect of pumpkin seed oil supplementation (Cucurbita pepo L.) on atherosclerosis due to an atherogenic diet | Randomized to the control and experimental group | Atherogenic rats supplemented with pumpkin seeds showed a significant decrease (p = 0.001) in their serum concentrations of total cholesterol and low-density lipoprotein cholesterol as they dropped from 8.33 mmol/L to 2.35 mmol/L and from 3.33 mmol/L to 0.70 mmol/L, respectively. Serum concentrations of high-density lipoprotein cholesterol were also significantly elevated in the same group. Although, atherogenic rats supplemented with 2% arginine showed significant increase in serum concentration of high-density lipoprotein-cholesterol, no significant changes were observed in their serum concentrations of total cholesterol and low-density lipoprotein-cholesterol. Pumpkin seed oil from C. maxima significantly reduced the degree of overactive bladder symptom score in the subjects. Pumpkin seed oil extracts from C. maxima as well as from C. pepo are effective for urinary disorders such as overactive bladder in humans. Biscuits fortified with nutritious pumpkin seed flour were made with four different levels of pumpkin seed flour substitution in wheat flour (T2 = 5%, T3 = 10%, T4 = 15% and T5 = 20%), compared to control (T1). The chemical attributes of biscuits show that T5 has the highest levels in pumpkin flour (20%) with the maximum protein (12.30%), fat (28.29%), ash (4.13%), iron (2.28%), and zinc (3.11%). The sensory results also show an increasing trend in all sensory parameters. |
| 6   | Nishimura et al., /Japan/2014 [18] | Pumpkin seed oil extracted from Cucurbita maxima improve urinary disorder in human overactive bladder | Evaluating effects pumpkin seed oil from Cucurbita maxima against dysfunction urinary tract in human overactive bladder | Experimental study | Pumpkin seed oil from C. maxima significantly reduced the degree of overactive bladder symptom score in the subjects. Pumpkin seed oil extracts from C. maxima as well as from C. pepo are effective for urinary disorders such as overactive bladder in humans. Biscuits fortified with nutritious pumpkin seed flour were made with four different levels of pumpkin seed flour substitution in wheat flour (T2 = 5%, T3 = 10%, T4 = 15% and T5 = 20%), compared to control (T1). The chemical attributes of biscuits show that T5 has the highest levels in pumpkin flour (20%) with the maximum protein (12.30%), fat (28.29%), ash (4.13%), iron (2.28%), and zinc (3.11%). The sensory results also show an increasing trend in all sensory parameters. |
| 7   | Kanwal et al., /Pakistan/2015 [19] | Development, physico chemical and sensory properties of biscuits supplemented with pumpkin seeds to combat childhood malnutrition in Pakistan | Develop high energy biscuits which is equipped with pumpkin seeds for improved nutrition and evaluate attributes chemical and organoleptic from extra biscuits | Experimental study | (Contd...) |
Pumpkin seeds are rich in oil and protein and, given its fatty acid profile, it lies in the linoleic-oleic group such as cotton seed, corn, sesame, sunflower, and soybean oil. With high oil yield and physicochemical characteristics similar to others commercial vegetable oil, pumpkin seed oil can be considered new and valuable source of vegetable oil [12]. Pumpkin seeds indicate highly nutritious and provide many nutrients essential for health [11]. Pumpkin seed oil is reported to have excellent nutritional properties, low seed toxicity, high quality of oil, ability to purify water, and adapt to poor soils and dry climates. Variation in the nutritive values depends on genetic background, environment, and cultivation methods. Leaves had high protein (28.4 g) and crude fiber (19.2 g) content but less fat (1.9 g) content whereas the fat content (0.1 g) was almost negligible in seeds. All 10 essential amino acids were present in both leaves and seeds with similar leucine, phenylalanine, threonine, and valine content. Leaves had high isoleucine and low tryptophan content. Seeds had high arginine and low tryptophan content. Seeds had high arginine and low tryptophan content.

Moringa is reported to have excellent nutritional properties, low seed toxicity, high quality of oil, ability to purify water, and adapt to poor soils and dry climates.
calcium, potassium, sulfur, magnesium, phosphorous, and iron content whereas copper content was high in seeds. Vitamin E (tocopherol) content was high in leaves whereas seeds had high Vitamin C (ascorbic acid) content. Vitamin B2 (riboflavin) content of seeds was negligible and Vitamin E was absent. Vitamin B5 (pantothenic acid) and B9 (folate) content were similar in leaves and seeds. Folate was found in both leaves and seeds. The low content of Vitamin C in leaves may be due to oxidation loss during air drying at room temperature. It is thus evident that Moringa leaves are nutrient dense providing essential micronutrients. Saponins, flavonoids, steroids, glycosides, and polyphenols were present in leaves and seeds. Terpenoids were present in leaves but not in seeds. Moringa is known for its high antioxidant activity among all fruits and vegetables [14].

Effect of pumpkin seeds and Moringa leaf extract on Hb, ferritin, CRP, and outcome pregnancy

The nutritional status of pregnant women supports the birth of a healthy baby and reduces the risk of morbidity in the baby. The fulfillment of adequate nutrition during pregnancy plays a very important role in the process of fetal growth and development. The nutritional adequacy of pregnant women will affect the condition of the fetus in its growth and development during pregnancy to the outcome of birth.

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Pregnant women have nutrition intervention through iron supplementation, folic acid, MMN, Vitamin D, and zinc supplementation which has an impact on pregnancy outcomes. Intervention of pregnant women through pumpkin seed biscuits is expected to have an impact on Hb, ferritin, CRP levels, LBW, and reduces the incidence of stunting in children. Pumpkin seeds are a good source of phytoestrogens and may exert weak estrogenic or anti-estrogenic effects. Studies in postmenopausal women have demonstrated that pumpkin seed oil, at a dose of 2 g per day for 12 weeks, can decrease blood pressure and reduce menopausal symptoms also decrease CRP [8]. Intervention with ready-to-eat cereal (providing 7.1 mg iron/day) plus 30 g of pumpkin seed kernels (providing 4.0 mg iron/day) for 4 weeks contributes to maintaining optimal nutritional status and minimizing the likelihood of iron insufficiencies in woman reproductive age which was increasing of serum iron, percent transferrin saturation, and reducing TIBC [15]. The formulation of amla, jaggery, and pumpkin leaves shows a greater potential in the combination therapy of herbal medicines in the management of anemia which was influence to increase hemoglobin, Vitamin C, and iron plasma in adolescents girls with iron deficiency anemia [16]. Study in Egypt was showed that supplementation of cooked soybean, cooked lentils, sesame seed, pumpkin seed, molasses, and mixture of them (soybean + lentils + sesame seed + Pumpkin seed powder + molasses) with ascorbic acid in rats revealed significant increase in Hb, Hct, mean corpuscular volume, mean corpuscular Hb, MCH concentration (MCHC), red blood cell, white blood cell, serum iron, and significant decreased in PT and TIBC [4]. Treatment of atherogenic rats with pumpkin seeds significantly decreased serum concentrations of total cholesterol and low-density lipoprotein-cholesterol, which explained pumpkin seeds supplementation has a protective effect against atherogenic [17]. Pumpkin seed oil extracted from C. maxima has the potential for prevention or treatment of urinary disorders including dysfunction urinary tract on human overactive bladder [18]. Study supplementation pumpkin seeds biscuit to combat malnutrition in Pakistan was showed that pumpkin seed flour can be supplemented successfully to partially replace wheat flour to prepare highly nutritious biscuits without affecting its overall acceptability [19].

Intervention of pregnant women through Moringa leaf extract capsules is expected to have an impact on Hb, ferritin, CRP levels, LBW, and reduces the incidence of stunting in children. Supplementation of M. oleifera leaf extracts significant increases of Hb level to 58% compared with the control group, M. oleifera extract is able to retain ferritin serum level dismount up to 50% [20]. Intervention of M. oleifera L. leaves significantly increased of mean Hb, ferritin, MCHC, and red cell distribution width and decreased of platelets. One thousand and four hundred milligrams of Moringa extract per day increased significantly hemoglobin and the result higher than control group [21]. Moringa leaf capsule can increase Hb level of adolescent girl, especially for anemia [22]. Supplementation of M. oleifera biscuit significant influences the increasing of hemoglobin in pregnancy anemia [23].

Moringa extract give evidence to utilize local food in order to prevent anemia and adverse pregnancy outcome [24]. M. oleifera has significantly increased hemoglobin concentration among anemic women [25]. Intervention of Moringa leaf significant increasing Hb levels of pregnant women [26]. For birth weight, supplementation using Moringa extract has positive effect on LBW prevention [20].

Conclusion

The provision of pumpkin seed biscuits and Moringa leaf extract to pregnant women can affect Hb, ferritin, and CRP levels and can affect maternal nutritional status and affect pregnancy outcomes.
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