Int J Adv Life Sci Res. Volume 7(1) 139-146
https://doi.org/10.31632/ijalsr.2024.v07i01.015

International Journal of Advancement in Life Sciences Research

Online ISSN: 2581-4877

Journal homepage http://ijalsr.org

Original Article

Formulation High Energy and Rich Iron of Granola Snackbar as a Nutritional Supplementary Feeding to Prevent Malnutrition in Pregnant Women

Dewinta Hayudanti, Rossa Kurnia Ethasari*, Luki Mundiastuti

Sekolah Tinggi Ilmu Kesehatan Hang Tuah Surabaya, Jawa Timur 60244, Indonesia

**Correspondence E-mail: rossakurniae@stikeshangtuah-sby.ac.id*

Abstract

Background: Providing supplementary feeding from local food is one strategy to address the nutritional problems of pregnant women in Indonesia. Improper eating habits of pregnant women are one of the causes of nutritional disorders, one of which is anemia and chronic lack of energy. The aim of this research was to develop and evaluate high-energy and rich-iron granola snackbars as a nutritional supplementary feeding to prevent malnutrition in pregnant women. Granola snackbars (formulas P1, P2, P3, and P4) were prepared using the same ratios of seaweed, moringa leaves, beetroot oats, nuts (peanuts, walnuts, and almonds), cornstarch, peanut butter, fish oil, salt, sugar, and water, in addition to chicken liver formulation and snakehead fish (P1: 0 gr, 75 gr), (P2: 10 gr, 65 gr), (P3: 20 gr, 55 gr), and (P4: 30 gr, 45 gr). **Methods**: The method employed a fully randomized design in a pure experimental setting. Proximate testing involved determining the snackbars' color, texture, taste, and aroma, as well as their energy, protein, fat, carbohydrate, and Fe contents. Organoleptic testing covered these aspects as well. **Results**: Formula P2 had the highest energy (521.01 kcal), and Formula P4 had the highest Fe value at 4.34%. The organoleptic test showed that the most preferred formulation was the formulation with a proportion of Formula P2. **Conclusion**: This study recommends using Formula P2 as a source of energy to prevent malnutrition in pregnant women and Formula P4, which has a high iron content, to improve the hemoglobin level in pregnant women.

Keywords: *Pregnant women, malnutrition, Snackbar*

Introduction

In Malnutrition among pregnant women continues to increase unnoticed in low-income countries as a major predictor of adverse birth outcomes (IYCNP 2012; Salam 2013). The World Health Organization (WHO) reported in 2018 that the global prevalence of chronic energy deficiency (CED) during pregnancy is 35-75%. The WHO also states that 40% of maternal deaths in developing countries are related to CEC (WHO, 2018). Based on data from basic health surveys conducted by the Agency for Health Research and Development in 2017–2018, approximately 17.3% of pregnant women in Indonesia experienced Chronic Energy Deficiency (CED), and the prevalence of anemia in pregnant women was estimated to be around 48.9% (Riskesdas, 2018).

Anemia is also a problem in pregnancy; worldwide, about 32.4 million pregnant women suffer from anemia, with about 48.7% in Southeast Asia and 46.3% in Africa (WHO, 2015). According to the results of the Basic Health Survey (Riskesdas, 2018) conducted in 2018, the frequency of anemia among pregnant women in Indonesia increased from 37.1 percent in 2013 to 48.9 percent in 2018. Therefore, the occurrence of anemia during pregnancy emerges as a health concern within broader

Received on :3rd November 2023; Revised version received on 1st December 2023; Accepted: 30th December 2023

society, exposing affected women to increased susceptibility to various complications for both the fetus and the woman, both during and after the pregnancy period. (Chopra *et al.*, 1971; Baker *et al.*, 2000; Stoltzfus *et al.*, 2003). Negative health effects persist throughout childhood with poor long-term outcomes unless the disorder is corrected early (Allen 1997; Lozoff *et al.* 1991). In addition, intrauterine growth retardation, preterm birth, low birth weight, and fetal death are common side effects of anemia (Hassan, 2014). Internationally, it is acknowledged as an indicator of numerous detrimental health and socioeconomic repercussions. This is because anemia hampers physical well-being, cognitive advancement, and productivity and signifies inadequate economic progress in a nation. (WHO, 2015; Stevens, 2013). Various national nutrition programs and strategies to prevent and manage micronutrient deficiencies have been implemented to reduce anemia in pregnant women (Government of the Federal Democratic Republic of Ethiopia, 2013, Rajkumar, 2011). Despite several attempts, maternal anemia remains a major public health problem (Lone, 2004).

According to the National Team for the Promotion of Poverty Eradication (2017), providing additional food to pregnant women can solve nutritional problems. The consumption of nutritional supplements by pregnant women with nutritional problems has the greatest impact in the second and third trimesters (Imdad *et al.*, 2017). Complementary food should be given as a snack, as a nutritional supplement in the form of whole grains can weaken the mother's nutritional status and is usually not desirable (Nurina, 2016). Additional food in the form of a snack can be prepared as an accessory because it is a balanced diet, easy to carry, and can be enjoyed between meals (Pallavi *et al.*, 2015).

Snack bars have a high nutritional value because they contain a lot of protein, energy, fiber, vitamins, antioxidants, etc. It is usually made from many ingredients, such as grains, dried fruits, nuts, raisins, sugar, etc., and is enriched with several different proteins, such as soybeans, with extensive use of whey proteins, cereals, barley, vitamins, and minerals. (Lobato 2012, Gonzalez 2003)

Oats are one of the main ingredients commonly used in foods for their fiber content and some dietary fibers, mainly β-glucan, which are said to cause cancer, hypercholesterolemia and increase blood pressure (Rasane, 2015). It is also a balanced food component and an excellent source of high-quality proteins and carbohydrates. In addition, it contains high amounts of unsaturated fatty acids, vitamins, minerals, and phytochemicals (Head, 2010). Moringa leaves are a local plant with micronutrient content such as beta-carotene, thiamine (B1), riboflavin (B2), niacin (B3), calcium, iron, phosphorus, magnesium, zinc, and vitamin C (Khuzaimah *et al.*, 2015). Seaweed (Eucheuma sp.) has iron, magnesium, sodium, amino acids, vitamins, and minerals that reach 10–20 times higher compared to terrestrial plants. The increase in haemoglobin levels will be more significant when combined with foodstuffs that contain Fe absorption aids, namely vitamin C (Arianti, 2021). Beetroot (Beta vulgaris L.) stands out as a primary vegetable source of iron, nitrate, sodium, potassium, and betalain (Ali, 2023). Chicken liver is rich in iron, containing a substantial amount of 8.99 mg per 100 grams (Santosa, 2016). Cork fish is rich in nutrients needed by the body, especially protein (Sunita, 2004). Mustafa *et al.* (2013), in their research, found that cork fish contain Cu, Fe, Ca, and Zn. Cork fish has the highest albumin content compared to other fish (Santosa, 2016). Therefore, researchers are interested in making a product formulation in the form of Snackbar with five main ingredients consisting of seaweed, moringa leaves, beetroot, chicken liver, and cork fish as an alternative high-iron food for pregnant women. The state of the art of this research begins with maternal mortality in Indonesia, which stems from various factors. Direct obstetric causes comprise bleeding (28%), preeclampsia/eclampsia (24%), and infection (11%). Meanwhile, indirect causes encompass nutritional issues, notably anemia in pregnant women (40%), chronic energy deficiency (37%), and pregnant women with energy consumption below the minimum requirements (44.2%). (Alamsyah, 2020).

The objective of this study is to create and assess granola snack bars with high energy and iron content, serving as a nutritional supplement and an alternative treat for pregnant women facing chronic energy deficiency and anemia. The intention is to provide a supplemental dietary option to support the health of these pregnant women during maternity. These snack bars, enriched with highcalorie and iron content, are intended to serve as supplementary nourishment for pregnant women dealing with chronic energy malnutrition and anemia.

Material and Method

Materials

The snackbar formulation is prepared utilizing a blend of ingredients comprising chicken liver, snakehead fish, beets, wheat, seaweed, moringa leaves, almonds, peanuts, walnuts, cornstarch, peanut butter, fish oil, salt, granulated sugar or honey, vanilla flavoring, and water. The snack bar formulation is served in 100 grams of dough.

Making snackbars starts with washing and cleaning the ingredients to be used, namely chicken liver, cork fish, beetroot, seaweed, moringa leaves, and other complementary ingredients such as oats, nuts (peanuts, walnuts, and almonds), cornstarch, peanut butter, fish oil, salt, sugar, and water. It starts with washing, weeding, and filleting (separating the head, entrails, and bones) of the cork fish. The fillets of cork fish and chicken liver were soaked in orange juice for 30 minutes. The soaked cork fish and chicken liver were then cut into small squares and dried at 50 °C. Beets were cleaned, diced, and dried at 50 °C. Making Snackbar starts with mixing chicken liver, cork fish, beetroot, seaweed, moringa leaves, and other complementary ingredients such as oats, nuts (peanuts, walnuts, and almonds), cornstarch, peanut butter, fish oil, salt, sugar, and water according to the treatment, then molding.

Tabel 1. Composition of ingredients in high energy and rich iron in snackbars (g/100 g)

Composition	**Weight (g)**			
	P1	P2	P3	P4
Chicken liver	0	10	20	30
Cork Fish Meat	75	65	55	45
Wheat	10	10	10	10
Beet	2	2	2	2
Seaweed	0.5	0.5	0.5	0.5
Moringa leaves	0.5	0.5	0.5	0.5
Almonds	2	2	2	2
Nuts	2	2	2	2
Walnuts	2	2	2	2
Corn flour	1.5	1.5	1.5	1.5
Peanut butter	1	1	1	1
Butter	1	1	1	1
Fish Oil	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Sugar or honey	0.5	0.5	0.5	0.5
Vanilla flavor	0.5	0.5	0.5	0.5
Water	0.5	0.5	0.5	0.5
Total	100%	100%	100%	100%

Method

The methodology employed in this study involved three sequential steps. The initial step encompassed formulating the product through a pure experimental approach, utilizing a Completely Randomized Design (CRD) with three replications.

The second step of proximate testing is carried out by analyzing the water, ash, protein, fat, carbohydrate, and iron content. Then we obtained 4 formulations that will be analyzed for nutritional content, among others: analysis of ash content utilizing the AOAC method; assessment of protein content was conducted through the application of the Kjeldahl method; assessment of fat was conducted through the application of the Soxhlet method; analysis of carbohydrate content using the by difference method; and analysis of iron and vitamin C content using the AAS spectrophotometer method, which will be carried out at the Laboratorium Sararaswanti, PT. Saraswanti Indo Genetech Surabaya.

After that, organoleptic testing was carried out, which included the characteristics of color, texture, taste, and aroma. The sampling method employed in this study was accidental sampling. Sensory evaluation of snack bar samples was subjected to sensory evaluations by 30 respondents for organoleptic tests consisting of 15 semi-trained panelists and 15 trained panelists. Semi-trained panelists were carried out by students of the Stikes Hang Tuah Surabaya Nutrition S1 Study Program, while trained panelists were carried out by a team at the UPT Laboratorium Gizi Surabaya, utilizing a 9-point hedonic scale (ranging from "Like extremely" to "Dislike extremely") to assess the product's acceptability in terms of color, flavor, taste, texture, and overall desirability. (Obatolu *et al.*, 2006)

The third step of this study involved assessing the acceptability of the snack bar among the designated subjects. The design employed in this acceptability test is descriptive, aiming solely to understand the subjects' acceptance of the product. 20 people, consisting of women of reproductive age and pregnant women, were panelists.

Data generated from nutrient analysis tests such as the assessment of moisture content, ash content, protein content, fat content, carbohydrate content, Fe content, and Vitamin C will undergo testing through one-way analysis of variance (ANOVA) using the SAS statistical analysis software. Mean comparisons will be conducted using Duncan's test at a significance level of $P < 0.05$. This study has obtained approval from the research ethics committee of Stikes Hang Tuah Surabaya reference number PE/65/VII/2023/KEP/SHT.

The research was carried out at the Saraswanti Indo Genetech Surabaya laboratory, and analysis was carried out in August–September 2023. Receptivity testing was carried out in Surabaya, with the research subjects being adult women and pregnant women.

Results and Discussion

Chemical analysis and energy content

Ash content is an important indicator that reveals the mineral elements in food products. The ash content in the snackbars formula in Table 2 ranges from 3.97% to 4.16%, and the highest significant value is found in formula P1 compared to formulas P2, P3, and P4 (Van *et al.*, 2018). They reported that sackbars enriched with oats showed a significant increase in ash content, which contributes to a good mineral supply in the snackbar.

The air content in the snackbars formula in Table 2 ranges from 4.99% to 5.85%, and the lowest significant value is found in formula P1 compared to formulas P2, P3, and P4. In ready-to-eat products, such as cereals, the low water content is used to obtain better quality so that they can be stored longer without using preservatives. This method proves highly efficient in preventing the occurrence of rancidity, even over extended periods of time. The stability of such bars is intricately connected to maintaining low air content and air activity. (Pallavi *et al.*, 2015).

Significant variations in carbohydrate, fat, and protein content were found in the five formulations tested. Snack bars with high carbohydrate content ranged from 39.9% to 39.5% (Table 2), while snack bars with high protein content ranged from 19.7% to 21.7% (Table 2). Snack bars with high fat content range from 30.4% to 31.9% (Table 2). P1 possesses the highest nutritional content, particularly in the form of carbohydrates; P2 exhibits the highest nutritional content in terms of fat and energy; P3 excels in protein content; and P4 leads in iron (Fe) content. The combination of ingredients employed in this study is designed to serve as supplementary nourishment for pregnant women grappling with chronic energy malnutrition and anemia.

Tabel 2. Proximate Analysis

Component	Formula			
	P1 (25)	P2 (37)	P3 (44)	P4 (56)
Moisture (%)	4.99±0.89[a]	5.58±0.07[b]	5.85±0.01[c]	5.57±0.80[b]
Ash(%)	4.16±0.26[b]	4.12±0.01[b]	4.01±0.05[a]	3.97±0.05[a]
Protein (%)	20.4±0.14[b]	20.4±0.60[b]	21.7±0.05[c]	19.7±0.78[a]
Fat (%)	30.4±0.19[a]	31.9±0.03[c]	30.58±0.12[a]	31.2±0.28[b]
Carbohydrate (%)	39.9±0.22[b]	37.8±0.05[a]	37.7±0.13[a]	39.5±0.63[b]
Fe (mg)	3.66±0.17[a]	3.80±0.18[a]	4.16±0.15[b]	4.29±0.13[b]
Energy (Kkal)	515.62±0.76[b]	521.08±0.15[d]	513.43±0.85[a]	518.02±0.97[c]

The energy content in the snackbar is sufficient for the additional nutritional value needed by pregnant women in the third trimester, reaching 521.01 kcal per day, the highest at P2. The increase takes into consideration the heightened metabolism of both the mother and the fetus, along with the requirements for fetal and placental growth. By dividing the total energy cost by the average duration of pregnancy (250 days from the first month), the suggested additional intake of 300 kcal/day covers the entire pregnancy period (Forsum 2007, Trumbo 2002). "So, this snack bar can be adapted as a supplementary food for pregnant women, serving as an additional source of energy. The recommended protein intake during pregnancy is 60 g/day, indicating a rise from 46 g/day in non-pregnant conditions. Put differently, this increase signifies a shift from 0.8g of protein/kg/day for non-pregnant states to 1.1g of protein/kg/day during pregnancy (Trumbo, 2002). A maternal protein intake of 10 g/day over the Recommended Dietary Allowance (RDA) for protein (i.e., a total of 60 g/day) is recommended throughout pregnancy. The protein in this granola snack bar is quite high if used as an additional snack for pregnant women, 19.7–21.7 mg.

The need for iron is notably heightened during pregnancy and infancy, requiring an estimated 1000–1200 mg of iron throughout the gestational period (Milman *et al.*, 2017; Fisher *et al.*, 2017). Generally, pregnant women need more iron than non-pregnant women to support the growth of the fetus and placenta, as well as to increase the mother's red blood cell mass. Iron requirements during pregnancy are lower in the first trimester (0.8 mg/day) compared to the pre-pregnancy period and significantly higher in the third trimester (3.0-7.5 mg/day) (Bothwell, 2000). About two-thirds of the iron needed during pregnancy is used for the mother's needs, and one-third is utilized for the needs of placental-fetal tissues. The majority of the 330–400 mg required for fetal growth is necessary in the last trimester (Vricella, 2017). It is crucial to enhance the diet of pregnant women by incorporating food supplements that provide essential nutrients beneficial for both the maternal and fetal organisms. Supplements for pregnant women can be in the form of additional food given during pregnancy, for example, snack bars with high energy and rich iron. The iron content in the snack bar is highest at P4, namely 4.31 mg, which means the snack bar can fulfill the daily iron needs of pregnant women during the first trimester (0.8 mg/day) and can meet half the iron requirements during pregnancy in the third trimester (3.0-7.5 mg/day). Pregnancy is linked to elevated iron requirements, consequently raising the likelihood of experiencing iron deficiency anemia. As many as 52% of pregnant women in developing countries are impacted (Sato *et al.*, 2010).

Sensory Analysis

Tabel 3. Sensory analysis

Formula	Colour	Flavor	Aroma	Texture
P1	3.90	3.27	3.27	3.77
P2	3.73	3.70	3.27	3.73
P3	3.50	3.77	3.60	3.77
P4	3.73	3.50	3.27	3.70
Nilai P	0.000	0.000	0.000	0.000

* Anova test

The outcomes of the ANOVA test indicate notable distinctions in preferences for color (p = 0.000), taste (p = 0.000), texture (p = 0.000), and aroma (p = 0.000). This implies that there are substantial differences among the four snack bar groups, with p-values less than 0.05, signifying statistical significance. According to the panelist test, treatment P1 received an average rating of 3.90 for color, while treatment P3 received an average rating of 3.50. In terms of taste, panelists tended to like treatment P3 with an average of 3.77, while panelists did not like treatment P1 with an average of 3.27. The aroma most liked by panelists was treatment P3, with an average of 3.60, while treatments P1, P2, and P4 were not liked by panelists on average. In terms of texture, panelists liked treatments P1 and P3 with an average of 3.73, while panelists did not like treatment P4 with an average of 3.70.

Acceptability testing

Tabel 4. Acceptability test

Acceptability	(n)	Percentage (%)
Like	19	63.33
Dislike	11	36.67
Total	30	100.0

Referring to Table 4, it is evident that nearly all women in the productive age group and pregnant women serving as panelists expressed their fondness for snack bars, amounting to 63.33%. Therefore, snack bars can be given directly as additional food for third trimester pregnant women.

Analysis of the portion of snackbar

Based on the standards of the Indonesian Ministry of Health regarding providing additional food for pregnant women, snack bars contain 510–530 kcal, 23–27 grams of protein, and 19–23 grams of fat (Indonesian Ministry of Health, 2023). Based on the research results, the P2 snackbar chosen by the panelists contains calories of 521.01 Kcal and 3.96 grams of iron per 100 grams of snackbar, while the P4 snackbar has the highest iron content, namely 4.34 grams. Therefore, the recommended serving size to provide supplemental nutrition is 60–80 grams of snack bars per day. It is evident that the energy content of this snackbar is sufficient to provide pregnant women with the additional nutritional value they require.

Conclusion

The most effective energy formulation identified in this study was found in snackbar P2, characterized by a ratio of 25 chicken livers to 65 cobs. It is recommended to prevent malnutrition in pregnant women. The most optimal iron formulation is P4, with a ratio of 35 chicken livers to 45 cobs. It is recommended to improve the hemoglobin level in pregnant women. The organoleptic test results show that the snackbar that meets the organoleptic test is the P2 snackbar with a composition of 25 chicken livers and 65 cobs because it is in great demand by pregnant panelists compared to the P3 and P4 snackbars with a composition of 30 chicken livers and 55 cobs, and the P4 snackbar with a composition of 35 chicken livers and Cob 45 is less popular because it contains more chicken liver and makes the snackbar taste fishy.

The acceptability test was carried out on two groups of panelists, namely the trained and untrained groups. From the outcomes of the acceptability test, it is apparent that 63.33% of pregnant women and women of childbearing age expressed a positive liking toward the snack bar, while 36.67% did not find it appealing.

It is recommended to re-examine the formulation of high-energy and iron-rich snack bars for pregnant women in the third trimester to determine the potential of antioxidants and other functional foods as alternatives for pregnant women.

Acknowledgement

The research in this article was funded by the Indonesian Ministry of Education, Culture, Research, and Technology through the Research Grant Program with the 2023 Beginner Lecturer Research Scheme. We would like to thank LP3M Sekolah Tinggi Ilmu Kesehatan Hang Tuah Surabaya, UPT Laboratorium Gizi Surabaya, and PT. Saraswanti Indo Genetech Surabaya, students of Bachelor Nutrition at Sekolah Tinggi Ilmu Kesehatan Tuah Surabaya, productive aged women, and pregnant women in the Surabaya area.

Conflict of interest:
No conflict of interests.

References

Alamsyah, Wasfaed. 2020. “Faktor-Faktor Yang Berhubungan Dengan Kejadian Penyakit Anemia Pada Ibu Hamil Usia Kehamilan 1-3 Bulan Diwilayah Kerja Puskesmas Bontomarannu Kabupaten Gowa.” *Jurnal Inovasi Penelitian* 1(2): 41–48. https://doi.org/10.47492/jip.v1i2.48

Ali, Z. A., & Bilal, A. (2023). Efficacy Assessment of Beetroot Extract in Regulating Iron Deficiency Anemia in Anemic Rats. *Pakistan Journal of Science*, 75(1), 88-93. https://doi.org/10.57041/pjs.v75i1.826

Allen, L. H. (1997). Pregnancy and iron deficiency: unresolved issues. *Nutrition reviews*, 55(4), 91-101. https://doi.org/10.1111/j.1753-4887.1997.tb06460.x

Arianti, S. A., Lestari, S., & Kartadarma, S. (2021). Minuman Rumput Laut Dan Madu Dapat Meningkatkan Haemoglobin Pada Ibu Hamil. *Jurnal Kebidanan Malahayati*, 7(4), 738-743. https://doi.org/10.33024/jkm.v7i4.4871

Baker Jr, W. F. (2000). Iron deficiency in pregnancy, obstetrics, and gynecology. *Hematology/oncology clinics of North America*, 14(5), 1061-1077. https://doi.org/10.1016/S0889-8588(05)70171-4

Bothwell, T. H. (2000). Iron requirements in pregnancy and strategies to meet them. The American journal of clinical nutrition, 72(1), 257S-264S.

Chopra, J. G., & Kevany, J. (1971). International approach to nutritional anemias. *American journal of public health*, 61(2), 250-258. https://doi.org/10.2105/ajph.61.2.250

Fisher, A. L., & Nemeth, E. (2017). Iron homeostasis during pregnancy. *The American journal of clinical nutrition*, 106(suppl_6), 1567S-1574S.

Forsum, E., & Löf, M. (2007). Energy metabolism during human pregnancy. *Annu. Rev. Nutr.*, 27, 277-292. https://doi.org/10.1146/annurev.nutr.27.061406.093543

Gonzalez, E., & Draganchuk, M. (2003). Flavoring nutrition bars. *Cereal foods world*, 48(5), 250.

Government of the Federal Democratic Republic of Ethiopia (GotFDR, E). (2013). National nutrition programme June 2013-june 2015. Addis Ababa: government of federal democratic republic of Ethiopia. 2013. Available at http://www.unicef.org/ethiopia/National_Nutrition_Programme.pdf

Hassan, A. A., Mamman, A. I., Adaji, S., Musa, B., & Kene, S. (2014). Anemia and iron deficiency in pregnant women in Zaria, Nigeria. *Sub-Saharan African Journal of Medicine*, 1(1), 36. https://www.ssajm.org/article.asp?issn=WKMP-0047;year=2014;volume=1;issue=1;spage=36;epage=39;aulast=Hassan

Head, D. S., Cenkowski, S., Arntfield, S., & Henderson, K. (2010). Superheated steam processing of oat groats. *LWT-Food Science and Technology*, 43(4), 690-694. https://doi.org/10.1016/j.lwt.2009.12.002

Imdad, A., Lassi, Z., Salaam, R., & Bhutta, Z. A. (2017). Prenatal nutrition and nutrition in pregnancy: effects on long-term growth and development. In Early Nutrition and Long-Term Health (pp. 3-24). Woodhead Publishing. https://doi.org/10.1016/B978-0-08-100168-4.00001-X

IYCNP 2012. Guidance for formative research on maternal nutrition. Available at: http://www.iycn.org/ resource/guidance-for-formative-research-on-maternal-nutrition/. Accessed on January 12, 2020. Available at: www.scitcentral.com 158: 2. 8 .

Kemenkes, R. I. (2023). PETUNJUK TEKNIS Pemberian Makanan Tambahan (PMT) Berbahan Pangan Lokal untuk Balita dan Ibu Hamil. Kemenkes (Internet), 78-81. https://kesmas.kemkes.go.id/assets/uploads/contents/others/20230516_Juknis_Tatalaksana_Gizi_V18.pd f

Khuzaimah, A., Hadju, V., As, S., Abdullah, N., Bahar, B., & Riu, D. S. (2015). Effect of honey and Moringa oleifera leaf extracts supplementation for preventing DNA damage in passive smoking pregnancy. Int J Sci Basic Appl Res, 24(1), 138-45. https://core.ac.uk/download/pdf/249334805.pdf

Lobato, L. P., Iakmiu Camargo Pereira, A. E., Lazaretti, M. M., Barbosa, D. S., Carreira, C. M., Mandarino, J. M. G., & Grossmann, M. V. E. (2012). Snack bars with high soy protein and isoflavone content for use in diets to control dyslipidaemia. *International journal of food sciences and nutrition*, 63(1), 49-58. https://doi.org/10.3109/09637486.2011.596148

Lone, F. W., Qureshi, R. N., & Emanuel, F. (2004). Maternal anaemia and its impact on perinatal outcome. *Tropical medicine & international health*, 9(4), 486-490. https://doi.org/10.1111/j.1365-3156.2004.01222.x

Lozoff, B., Jimenez, E., & Wolf, A. W. (1991). Long-term developmental outcome of infants with iron deficiency. *The New England Journal of Medicine*, *325*(10), 687–694. https://doi.org/10.1056/NEJM199109053251004

Milman, N., Taylor, C. L., Merkel, J., & Brannon, P. M. (2017). Iron status in pregnant women and women of reproductive age in Europe. *The American journal of clinical nutrition*, *106*(Suppl 6), 1655S–1662S. https://doi.org/10.3945/ajcn.117.156000

Mustafa, A., Sujuti, H., Permatasari, N., & Widodo, M. A. (2013). Determination of nutrient contents and amino acid composition of Pasuruan Channa striata extract. *IEESE International Journal of Science and Technology*, 2(4), 1. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=a9dc6f957c21a2bd7ce3c9647d9365cfb4ef1feb

NurinaR. (2017). Program Pemberian Makanan Tambahan untuk Peningkatan Status Gizi Ibu Hamil dan Balita di Kecamatan Cilamaya Kulon dan Cilamaya Wetan, Karawang. *Jurnal Resolusi Konflik, CSR Dan Pemberdayaan (CARE)*, *1*(1). Retrieved from https://journal.ipb.ac.id/index.php/jurnalcare/article/view/15295

Obatolu Veronica, A., Omueti Olusola, O., & Adebowale, E. A. (2006). Qualities of extruded puffed snacks from maize/soybean mixture. *Journal of food process engineering*, 29(2), 149-161. https://doi.org/10.1111/j.1745-4530.2006.00054.x

Pallavi, B. V., Chetana, R., Ravi, R., & Reddy, S. Y. (2015). Moisture sorption curves of fruit and nut cereal bar prepared with sugar and sugar substitutes. *Journal of food science and technology*, *52*(3), 1663–1669. https://doi.org/10.1007/s13197-013-1101-0

Rajkumar, A. S., Gaukler, C., & Tilahun, J. (2011). Combating malnutrition in Ethiopia: an evidence-based approach for sustained results. World Bank Publications, The World Bank Group, number 2387, December.

Rasane, P., Jha, A., Sabikhi, L., Kumar, A., & Unnikrishnan, V. S. (2015). Nutritional advantages of oats and opportunities for its processing as value added foods - a review. *Journal of food science and technology*, *52*(2), 662–675. https://doi.org/10.1007/s13197-013-1072-1

Riskesdas, K. (2018). Main results of basic health research (RISKESDAS). *Journal of Physics A: Mathematical and Theoretical*, 44(8), 1-200.

Salam, R. A., Das, J. K., Ali, A., Lassi, Z. S., & Bhutta, Z. A. (2013). Maternal undernutrition and intrauterine growth restriction. Expert Review of Obstetrics & Gynecology, 8(6), 559-567. https://doi.org/10.1586/17474108.2013.850857

Santosa H, Handayani NA, Nuramelia C, Sukma NY. Pemanfaatan hati ayam sebagai penguat zat besi pada bubur bayi instan berbasis ubi jalar ungu (*Ipomoea batatas* L.). *Jurnal Inovasi Teknik Kimia*. 2016;1(1). DOI: http://dx.doi.org/10.31942/inteka.v1i1.1641

Sato, A. P. S., Fujimori, E., Szarfarc, S. C., Borges, A. L. V., & Tsunechiro, M. A. (2010). Food consumption and iron intake of pregnant and reproductive aged women. Revista latino-americana de enfermagem, 18, 247-254. https://www.scielo.br/j/rlae/a/hHwMLGLhnbg5X7ZhDDWnVHh/?lang=en&format=html

Setiyana, N. M., & Suprayitno, E. (2019) Identification of Amino Acid Profile, Fatty Acid Profile and Albumin from Cork Eggs (*Channa striata*). *International Journal of Scientific and Research Publications*, 9, (9), 753-759. https://doi.org/10.29322/IJSRP.9.09.2019.p93101

Stevens G.A., *et al.*, Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. *The Lancet Global Health*, 2013. 1(1): p. e16–e25. https://doi.org/10.1016/S2214-109X(13)70001-9

Stoltzfus R.J., Iron deficiency: global prevalence and consequences. Food and nutrition bulletin, 2003. 24(4_suppl_1): p. S99–S103. https://doi.org/10.1177/15648265030244S206

Trumbo, P., Schlicker, S., Yates, A. A., Poos, M., & Food and Nutrition Board of the Institute of Medicine, The National Academies (2002). Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. *Journal of the American Dietetic Association*, 102(11), 1621–1630. https://doi.org/10.1016/s0002-8223(02)90346-9

Van Toan, N., & Vinh, T. Q. (2018). Production of nutritional bars with different proportions of oat flour and brown rice flour. *Clinical Journal of Nutrition and Dietetics,* 1(1), 1-11. https://asclepiusopen.com/clinical-journal-of-nutrition-and-dietetics/volume-1-issue-1/5.php

Vricella L. K. (2017). Emerging understanding and measurement of plasma volume expansion in pregnancy. *The American journal of clinical nutrition*, *106*(Suppl 6), 1620S–1625S. https://doi.org/10.3945/ajcn.117.155903

WHO. (2018). Data and statistics. https://www.who.int/hiv/data/en/

WHO/UNICEF Joint Water Supply, & Sanitation Monitoring Programme. (2015). Progress on sanitation and drinking water: 2015 update and MDG assessment. World Health Organization.