

The potential of trigona honey as a hemoglobin booster and immunomodulator in pregnant women with iron deficiency anemia

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ABSTRACT

Background: Iron deficiency anemia in pregnancy constitutes a significant public health issue, as it elevates the likelihood of adverse pregnancy outcomes, including pregnancy complications. In West Lombok, the prevalence of anemia among pregnant women was reported to reach 18.6%. Despite government efforts through iron supplementation programs, challenges remain, including low adherence and limited bioavailability. Therefore, alternative natural supplements are needed. Trigona honey contains micronutrients and bioactive compounds with hematopoietic and immunomodulatory properties, making it a potential natural agent to improve hemoglobin levels and immune function. Objective: To examine the impact of Trigona honey supplementation on the hemoglobin levels of pregnant women with IDA. Methods: This true experimental research employed a pretest-posttest control group design and was carried out within the service area of the Jembatan Kembar Community Health Center. Thirty pregnant women were recruited using purposive sampling and divided into two groups: intervention (Trigona honey + iron) and control (iron only), each with 15 participants. Data were collected using questionnaires and Touch GCHB tests to measure hemoglobin levels. Statistical analyses were performed using paired and independent t-tests with a significance threshold of $p < 0.05$. Results: Hemoglobin levels increased significantly in both groups; however, the intervention group demonstrated a more substantial improvement (mean = 2.89; $p = 0.000$) compared to the control group (mean = 0.65; $p = 0.010$). Conclusion: Trigona honey significantly enhanced hemoglobin levels compared to iron supplementation alone. It may serve as a promising non-pharmacological complementary therapy for preventing and managing iron deficiency anemia in pregnant women.

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INTRODUCTION

Anemia is a condition characterized by a reduced number of erythrocytes or hemoglobin concentration below normal values, resulting in suboptimal oxygen delivery to body tissues (Febriani & Sijid, 2021). In pregnant women, this condition becomes more complex due to physiological increases in plasma volume during pregnancy, which are not always accompanied by proportional increases in red blood cell production. This imbalance is generally caused by inadequate nutritional intake, particularly insufficient iron, which plays an essential role in hemoglobin synthesis (World Health Organization, 2024).

Globally, anemia affects approximately 1.97 billion people, and 50–80% of cases are attributed to iron deficiency (Afrida & Aryani, 2022). In Indonesia, the 2018 National Basic Health Research (Riskesmas) reported that 48.9% of pregnant women experience anemia, with 60% of cases related to inadequate iron intake (Kemenkes RI, 2021; Nurmayani, Oktaviani, & Purqoti, 2021). In West Nusa Tenggara Province (NTB), the prevalence of anemia among pregnant women increased from 9% in 2019 to 10.88% in 2020 (Dikes Provinsi NTB, 2021). A similar pattern was observed in West Lombok Regency, where anemia prevalence rose from 12.07% (2018), to 15.62% (2019), reaching 18.6% in 2023. Specifically, in the working area of Jembatan Kembar Community Health Center, anemia cases increased twofold from 7% in 2022 to 14% in 2023 (Dikes Lombok Barat, 2022). These data illustrate that anemia among pregnant women remains a pressing public health issue requiring urgent intervention.

Anemia during pregnancy not only affects maternal health but also increases the risk of obstetric and neonatal complications, including preterm birth, low birth weight, maternal and infant mortality, and childhood stunting (Afrida & Aryani, 2022; Kemenkes RI, 2021). Although the government has implemented iron supplementation programs (Tablet Tambah Darah/TTD), their effectiveness is hindered by poor adherence, gastrointestinal side effects, and low iron bioavailability (Ekström et al., 1996; Lynch, 2005; WHO, 2012; Tang et al., 2006; Rianti, Fatmawati, & Suwarni, 2022). Beyond lowering hemoglobin levels, iron deficiency also impairs the immune system, increasing susceptibility to infections and negatively affecting fetal development (Allen, 2000; Baker, Greer, & Committee on Nutrition, 2010; Oppenheimer, 2001; Pavord et al., 2012; Scholl, 2005). These factors highlight the need for interventions that not only increase hemoglobin levels but also support immune function.

Indonesia, particularly Lombok, possesses abundant natural resources with potential for development as local health interventions. One promising natural product is *Trigona* honey derived from *Tetragonula laeviceps*. This honey is rich in micronutrients and bioactive compounds such as flavonoids, polyphenols, vitamins, minerals (including iron), and antioxidants (Asnawati, 2021; Supinganto, 2024). These compounds have hematopoietic and immunomodulatory properties (Agus et al., 2019; Ningsih et al., 2024; Nuristigfarin, 2022). Research has shown that consuming *Trigona* honey for 14 days can increase hemoglobin levels and enhance immune profiles among pregnant women (Puti Tika Rianti et al., 2022). Additionally, combining *Trigona* honey with citrus juice has been reported to improve immune function (Petrika, 2013).

Although previous findings are promising, research specifically evaluating the effectiveness of *Tetragonula laeviceps* honey as a hemoglobin enhancer in pregnant women with iron deficiency anemia (IDA) remains limited. Therefore, further studies are needed to provide stronger scientific evidence regarding the benefits of *Trigona* honey as a natural, locally sourced, and comprehensive intervention for anemia.

Based on this background, the present study aims to analyze the effect of *Trigona* honey on hemoglobin levels among pregnant women with iron deficiency anemia. The findings are expected to contribute to innovative nutritional interventions that not only improve hemoglobin levels but also strengthen the immune system, supporting overall maternal and child health.

RESEARCH METHOD

This study employed a true experimental design utilizing a pretest-posttest control group approach. The research was conducted in the working area of the Jembatan Kembar Community Health Center, Lembar Subdistrict, West Lombok Regency. The sample consisted of 30 respondents divided into two groups: 15 in the intervention group and 15 in the control group. Respondents were selected using purposive sampling based on inclusion criteria.

Inclusion criteria included: a) Pregnant women in the second or third trimester; b) Hemoglobin levels < 11 g/dL; c) No chronic illnesses such as HIV/AIDS or tuberculosis; d) Willingness to participate until completion.

Data were collected using questionnaires and hemoglobin measurements using the Easy Touch GCHb device. Statistical analysis employed paired t-tests and independent t-tests with a significance level of $p < 0.05$.

RESULTS AND DISCUSSION

Table 1. Pre-intervention anemia distribution

Anemia Category	Intervention Group (n = 15)		Control Group (n = 15)	
	n	%	n	%
Non-anemic	0 (0%)	0 (0%)	10	67,8
Mild anemia	4 (22.2%)	10 (67.8%)	5	32,2
Moderate anemia	11 (77.8%)	5 (32.2%)	15	100

Before the intervention, all pregnant women in both the intervention and control groups were categorized as anemic (100%). In the intervention group, 22.2% had mild anemia, while 77.8% had moderate anemia. In the control group, 67.8% had mild anemia and 32.2% had moderate anemia. No respondents in either group were non-anemic.

Most pregnant women were aged 20-35 years, the reproductive age group that has increased nutritional requirements during pregnancy, placing them at higher risk for anemia. This age range is associated with significant physiological changes, including increased iron needs to support fetal development and maternal well-being.

In terms of gravida status, most respondents were multigravida: 67.8% in the intervention group and 55.6% in the control group. Multigravida women face a higher risk of anemia due to cumulative iron depletion from previous pregnancies.

Socioeconomic factors also played an important role. Most respondents were unemployed, and many husbands earned below the regional minimum wage, limiting access to nutritious foods and supplements needed to prevent anemia. These findings are supported by previous research (Manikam, 2021; Sugiharti & Cahyaningrum, 2020).

Studies by Zhang et al. (2022) and VanderMeulen et al. (2021) similarly report that low education, limited income, young or advanced maternal age, and high parity are associated with increased anemia risk. These results align with findings from the Purwokerto South Community Health Center (2022).

Table 2. Post-intervention anemia distribution

Anemia Category	Intervention Group (n = 15)		Control Group (n = 15)	
	n	%	n	%
Non-anemic	15 (100%)	5 (32.2%)	3	32,2
Mild anemia	0 (0%)	2 (11.1%)	1	11,1
Moderate anemia	0 (0%)	8 (56.7%)	6	56,7
Severe anemia	0 (0%)	0 (0%)	15	100

After the intervention, all pregnant women in the intervention group (100%) were categorized as non-anemic. In contrast, the control group still showed 56.7% with moderate anemia, 11.1% with mild anemia, and only 32.2% classified as non-anemic.

These findings indicate a substantial difference between the intervention and control groups after 30 days of Trigona honey supplementation at 10 ml/day (13.6 g). All respondents in the intervention group transitioned to non-anemic status, demonstrating the strong efficacy of the intervention.

Consistent with Ahmady et al. (2021), Trigona honey's effectiveness may be attributed to its rich nutrient profile, including iron for hemoglobin synthesis, vitamin C to enhance iron absorption, and flavonoids and phenolics serving as antioxidants to protect red blood cells from oxidative damage. Bioactive enzymes in Trigona honey may also stimulate erythropoietin production (Biluca et al., 2016).

Trigona honey increases iron absorption through the synergy of iron and vitamin C while reducing oxidative stress via flavonoids and phenolic compounds. These mechanisms make Trigona honey a safe natural hemoglobin booster.

Additional studies (Asrida et al., 2022; Dahliansyah & Petrika, 2020) confirm that Trigona honey enhances hemoglobin levels more effectively than iron supplements alone.

Table 3. Statistical analysis

Grup	mean	Paired Differences				T	df	Sig (2-tailed)	
		Std. Deviation	Std. error mean	95% Confidence interval of difference					
				Lower	Upper				
Pretest Kontrol-Posttest Kontrol	- 6533	0.8543	0.2206	-1.1264	-.1802	-2.962	14	0.010	
Pretest Intervensi- Posttest Intervensi	- 2.8867	0.9606	0.2480	-3.4186	-2.3547	-	11.639	14	0.000

Paired t-test results showed significant increases in hemoglobin levels in both groups : a) Control group: mean increase = 0.653 g/dL, $p = 0.010$; b) Intervention group: mean increase = 2.887 g/dL, $p = 0.000$.

These results indicate that while iron supplementation alone can improve hemoglobin levels, the addition of Trigona honey yields a significantly greater effect. Trigona honey contains higher concentrations of bioactive compounds compared to conventional honey, such as: a) Iron (0.42 mg/100 g); b) Vitamin C (6.49-13.58 mg/100 g); c) Total phenolics (0.65-2.30% GAE/100 g); d) Flavonoids (0.28-1.00 mg QE/g); e) Antioxidant activity (61.43-90.28%)

These compounds support erythropoiesis, immune function, and reduced oxidative stress. Studies by Simatupang & Simanjuntak (2022) and Wibowo et al. (2021) further support the role of honey in improving oxidative markers and pregnancy outcomes. Demographic factors such as age, parity, education, employment, and household income influence the rate of hemoglobin improvement (Rianti et al., 2022; Rahayu, 2021; WHO, 2020).

CONCLUSION

Trigona honey was proven to significantly increase hemoglobin levels and enhance immune function among pregnant women with anemia. After the intervention, all women in the intervention group achieved non-anemic status, while the control group showed remaining anemia cases. The mean increase in hemoglobin was 2.8867 g/dL in the intervention group compared with 0.6533 g/dL in the control group. Statistical analysis showed a significant effect of Trigona honey ($p = 0.000$). Therefore, Trigona honey has strong potential as a non-pharmacological complementary therapy for preventing and managing iron deficiency anemia in pregnancy.

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