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BEETROOT (*Beta vulgaris L.*) AND ITS POTENTIAL AS AN ANEMIA TREATMENT IN PREGNANCY

BEETROOT (Beta vulgaris L.) DAN POTENSINYA SEBAGAI PENGOBATAN ANEMIA PADA KEHAMILAN

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ABSTRACT

Anemia is one of the most common nutritional problems in pregnant women. It is defined as a condition in which the hemoglobin (Hb) level is lower than normal. The main cause of anemia in obstetrics is iron deficiency. To prevent this condition, the Government of Indonesia through the Ministry of Health made a rule by giving iron tablets to pregnant women at least 90 tablets during pregnancy. However, some people are often bored with this pharmacological therapy due to the nausea and vomiting effect of the iron smell. Therefore, the development of alternative anemia therapy has been done to minimize those problems. One of the herbal ingredients that are being studied for its potential as anti-anemia in pregnancy is beetroot (Beta vulgaris L.). This research is included in the type of literature review. The selected literature is research articles published in the last 10 years (2013 to 2023). There are 10 articles that match the topic of study. A total of 7 publications demonstrated the effect of beetroot on anemia in pregnant women during the pregnancy period, and 2 articles in the post-partum period. A study performed in vivo experiments on pregnant female rats. Almost all of the studies did intervention by giving subjects beetroot juice. Only one study used beets as an intervention as ice cream. The results show that beetroot has the potential to prevent and treat anemia in pregnancy by increasing hemoglobin levels and the amounts of hematocrit. It contains a high level of folic acid which is important for normal cell and tissue growth. The iron content of beetroot also plays an essential role in the human body transporting oxygen to red blood cells, so it helps to cure anemia.

Keywords: *anemia, pregnancy, beetroot (Beta vulgaris L.), hemoglobin, hematocrit, folic acid*

ABSTRAK

Anemia merupakan salah satu masalah gizi yang sering terjadi pada ibu hamil. Ini didefinisikan sebagai suatu kondisi di mana kadar hemoglobin (Hb) lebih rendah dari normal. Penyebab utama anemia pada kebidanan adalah kekurangan zat besi. Untuk mencegah kondisi tersebut, Pemerintah Indonesia melalui Kementerian Kesehatan membuat aturan dengan memberikan tablet besi kepada ibu hamil minimal 90 tablet selama masa kehamilan. Namun, beberapa orang sering bosan dengan terapi farmakologi ini karena efek mual dan muntah dari bau besi. Oleh karena itu, pengembangan terapi anemia alternatif telah dilakukan untuk meminimalkan masalah tersebut. Salah satu bahan herbal yang sedang diteliti potensinya sebagai anti anemia pada kehamilan adalah buah bit (Beta vulgaris L.). Penelitian ini termasuk dalam jenis literature review. Literatur yang dipilih adalah artikel penelitian yang diterbitkan dalam 10 tahun terakhir (2013 hingga 2023). Terdapat 10 artikel yang sesuai dengan topik kajian. Sebanyak 7 publikasi menunjukkan efek buah bit terhadap anemia pada ibu hamil selama masa kehamilan, dan 2 artikel pada masa nifas. Sebuah penelitian dilakukan percobaan in vivo pada tikus betina hamil. Hampir semua penelitian melakukan intervensi dengan memberikan subjek jus bit. Hanya satu penelitian yang menggunakan bit sebagai intervensi sebagai es krim. Hasil penelitian menunjukkan bahwa buah bit berpotensi untuk mencegah dan mengobati anemia pada kehamilan dengan cara meningkatkan kadar hemoglobin dan jumlah hematokrit. Ini mengandung asam folat tingkat tinggi yang penting untuk pertumbuhan sel dan jaringan normal. Kandungan zat besi pada buah bit juga berperan penting dalam tubuh manusia mengangkut oksigen ke sel darah merah, sehingga membantu menyembuhkan anemia.

Kata kunci: anemia, kehamilan, buah bit (Beta vulgaris L.), hemoglobin, hematokrit, asam folat

INTRODUCTION

Pregnancy is a period of fetal development inside a woman's womb or uterus for about 40 weeks measured from the last menstrual period to delivery (NIH, 2017). This is an important phase of life that determines the quality of human resources (Kusumahati *et al.*, 2022). Several problems during pregnancy can impact both of mother and fetus. Anemia is one of the most scommon nutritional problems in pregnant women (Wulandari and Susiloningtyas, 2020). WHO estimates that 37% of pregnant women worldwide are anemic (WHO, 2023). In Indonesia, the prevalence of anemia in pregnant women is 48,9%. It is about 84.6% were found in those aged 15-24 years old (Kemenkes RI, 2022).

Anemia is a condition in which the hemoglobin (Hb) level is lower than normal (WHO, 2023). Hemoglobin is a protein found in the red blood cells (erythrocytes) that carries oxygen to the body's tissues and gives the red color to the blood. Pregnant women with anemia have Hb levels less than 10.5 g/ dL. Several factors of anemia in pregnancy are nutritional deficiencies, parasitic and bacterial diseases, and inborn red cell disorders such as thalassemias. The main cause of anemia in obstetrics is iron deficiency. It is estimated that 20-80% of the female population worldwide in an iron deficiency anemia condition. Several stages of iron deficiency are depletion of iron stores, iron deficient erythropoiesis without anemia, and iron deficiency anemia (Breymann, 2015).

Anemia in pregnant women can increase the risk of premature birth, maternal and children death, as well as infectious diseases. Iron deficiency anemia in pregnant women can affect the growth and development of the fetus/infant during and after pregnancy. To prevent this condition, the Government of Indonesia through the Ministry of Health made a rule by giving iron tablets to pregnant women at least 90 tablets during pregnancy (Kemenkes RI,

2022). However, some people are often bored with this pharmacological therapy due to the nausea and vomiting effect of the iron smell. Therefore, the development of alternative anemia therapy has been done to minimize those problems. One of the herbal ingredients that are being studied for its potential as an anti-anemia in pregnant women is beetroot (*Beta vulgaris L.*).

Beetroot is a kind of tuber that is reddish purple in color. It usually consume by juice or processed into soft texture food (Anggraini & Saragita, 2020). Beetroot have high content of folic acid and iron. These substances are needed to form red blood cells and new hemoglobin in the body (Risnawati *et al*., 2021). Therefore, the aim of the study is to review and find out more about the potential of beetroot (*Beta vulgaris L.*) to prevent and cure anemia in pregnancy.

METHODS

This study used literature review design. The articles were searched by using database sources from PubMed and Google Scholar. The articles were Indonesian and English research articles related to the potential of potential of beetroot (*Beta vulgaris L.*) as anti-anemia in pregnant women. The search is limited to research articles published within the last 10 years, namely 2013 to 2023 which can be accessed in full text in pdf format. Types of review articles were not used in this study. The keywords included “Iron deficiency anemia”, or “beetroot, iron, pregnancy”, or “beetroot, nutrition”, and “beetroot, anemia”. Obtained literatures then analyzed, compared, discussed, and concluded.

RESULT

The results of searching for articles in PubMed and Google Scholar yielded 10 publications that were relevant to the goal of the literature review. There are 7 publications that demonstrated the effect of beetroot on anemia in pregnant women during pregnancy period, and 2 articles in the post-partum period (Khairiah *et al.*, 2022; Lestari *et al.*, 2022; Istiqomah and Fauzi, 2022; Setyiyaningsih *et al.*, 2020; Sakdah and Idiana, 2022; Risnawati *et al.*, 2021; Wulandari and Susiloningtyas, 2020; Nurhasanah *et al.*, 2021; Rifni *et al.*, 2020). A study performed in vivo experiments on pregnant female rats (Zakiyah and Setyaningsih, 2019). Almost all of the studies did intervention by giving subjects beetroot juice. Only one study used beets as an intervention as ice cream (Rifni *et al.*, 2020).

Table 1 The result of articles publication about the potential of beetroot to prevent and overcome anemia in pregnancy

No	Author	Title	Population	Method	Result
1	Khairiah *et al.* (2022)	The Effectiveness Of Giving Beet Juice On Hb Levels In Third Trimester Pregnant Women At Budhi Asih Hospital In 2022	30 third trimester pregnant women with a gestational age of 28-36 weeks in the working area of Budhi Asih Hospital.	Quasi Experimental, with the Pretest and Posttest Control Group design.	Before receiving beetroot juice treatment, the mean anemia levels in the intervention group were 6.33 and 6.93, respectively. The mean level of anemia after receiving beetroot juice treatment was 11.20 in the intervention group and 4.80 in the control group.
2	Lestari *et al.* (2022)	The Effect of Giving Bit Juice with Prevention of Anemia in Pregnant Women in Trimester Iii at The Clinic of Dina Karya Medan in 2021	12 pregnant women in the third trimester.	Quasi-experimental with One-Group Pretest posttest without control.	Pre-post statistical data obtained in the third trimester of pregnancy show a Sig. (2-tailed) of 0.000 < 0.05.
3	Istiqomah and Fauzi (2022)	Effectiveness Of Beetroot And Spinach Against The Increase In Hemoglobin Levels Of Pregnant Women In The Primary Clinic Kasih Bunda in 2022	18 pregnant women	Quasi- experimental design based on the pre- and post-test with a single group. The intervention (consumption of beet juice and	The average hemoglobin level rises to 12.3 gr/dl after beet juice administration, and rise to an average of 11.4 g/dl after spinach administration.

No	Author	Title	Population	Method	Result
				spinach) were did for 28 days.	
4	Setyiyaningsih *et al.* (2020)	Effectiveness of Beet and Lemon Juice in Increasing Hemoglobin Levels in Pregnant Women	14 pregnant women with anemia in Wonorejo Village, Pringapus Public Health Service working area.	Pre-experiment design with one group pretest-posttest design.	Hemoglobin levels in anemic pregnant women were 10.25 g/dl before they received a beet and lemon fruit juice combination; after receiving the combinations, they were 11.35 g/dl, a rise of 1.1 g/dl on average.
5	Sakdah and Idiana (2022)	The Effectiveness of Beetroot Juice (*Beta vulgaris*) and Iron Tablets on Hemoglobin Levels of Pregnant Women in Sub-district of Darul Imarah, The District of Aceh Besar	30 of pregnant women with mild anemia in the villages of Gue Gajah and Garot Geuce	Quasi-experimental with nonequivalent control group design used	Before beet juice administration, pregnant women in the experimental group's average Hb level was 9.50 g/dL, while control group was 9.19 g/dL. After receiving beetroot juice; the experimental group had Hb level 11.27 g/dL while the control group had 9.22 g/dL. The statistical analysis revealed a significant increase with P value < 0.05
6	Risnawati *et al.* (2021)	Effectiveness of Beet Juice Administration on Hemoglobin Levels in Pregnant Women with Anemia in Tayu I Public Health Service	30 pregnant women who were divided into the control group and the experimental group	Quasi experimental with nonequivalent control group design	The hemoglobin levels mean difference of pregnant women with anemia in the group given Fe tablets was 0.16 gr/dl with a p-value of 0.004, while in the group given Fe tablets and beetroot juice was 0.88 gr/dl with p-value of 0.000.

No	Author	Title	Population	Method	Result
7	Wulandari and Susiloningtyas (2020)	Betroot (*Beta vulgaris*) administration to anemic pregnant women for increasing hemoglobin level	30 patients who were divided into 2 groups of treatment groups (beetroot + Fe) and control group (Fe). The treatment was carried out for 14 days. Intervention: 100 grams of beet is mixed with 2.5 glasses of water (total juice volume was 500 mL)	Experimental quantitative study using pretest-posttest design	Hemoglobin levels were significantly different between treatment and control group with p (0.023) < alpha (0.05). Fe and beetroot juice treatment to anemic pregnant women resulted in a minimum 17.7 g% increase in hemoglobin and a maximum hemoglobin level of 0.8 g%.
8	Zakiyah and Setyaningsih (2019)	Beetroot juice (*Beta Vulgaris L*) alternative handling of anemia in pregnancy	20 pregnant female rats. The samples were divided into 5 groups: 1) Negative control group 2) Positive control group 3) Iron supplementation 1.08 mg/BW 4) Beetroot juice 3.6 g/BW 5) Beetroot juice 1.8 g/BW	Experimental study with a Randomized Posttest Only Control Group Design.	The administration of 3.6 gr/BW beetroot juice was as effective as the supplementation of Fe 1.08 mg/BW in increasing hemoglobin levels.
9	Nurhasanah *et al.* (2021)	Comparative Analysis of Beet Juice and Red Guava Juice against Erythrocyte and Hematocrit Levels in Post-partum Women	45 post-partum mothers in the Darul Imarah Health Center, Darul Imarah District, Aceh Besar.	Quasi-experimental study with a pre-post test design using a randomized controlled trial.	There was a significant difference in hematocrit (HTC) levels between the guava+Fe, beet+Fe, and control (Fe) treatment groups with a p-value of 0.001 <0.05. The average difference between the guava and beet treatment groups in erythrocyte levels was 0.03. The mean difference in HTC levels was greater in the Bit+Fe treatment group than in the

No	Author	Title	Population	Method	Result
					guava+treatment group and the control group (Fe).
10	Rifni *et al.* (2020)	Beetroot ice cream as an alternative improvement of hematology status in anemic postpartum mothers who get Fe tablet supplementation	30 post-partum mothers were divided into 2 groups: 15 treatment groups and 15 control groups.	Quasy experiment with pretest posttest with control group design.	Anemic postpartum mothers' hemoglobin levels increased following 7 days of administration with 11 gram beet ice cream and Fe tablet supplementation.

DISCUSSION

Anemia is defined as a lower-than-normal hemoglobin (Hb) level (WHO, 2023). Hemoglobin is a protein present in red blood cells (erythrocytes) that transports oxygen to the body's tissues and gives blood its red color. Hb values in pregnant women with anemia are less than 10.5 g/dL (Breymann, 2015).

Anemia in Pregnancy

During pregnancy, the requirement of total iron is recommended to be around 1200 mg a day for a pregnant woman weighing an average of 55 kg. The iron is mostly needed to raise the maternal erythrocytes mass (450 mg), the placenta (90–100 mg), the fetus (250–300 mg), and general losses (200–250 mg). Additionally, a blood loss after delivery equal to 150 mg iron (300–500 mL blood loss) also uses iron. Up to 90% of women have iron reserves of less than 500 mg (serum ferritin 70 g/L), which is insufficient to fulfill the increased iron requirements throughout pregnancy and postpartum. Around 40% of women have little or no iron stores before the start of pregnancy. The first trimester's iron absorption needs are around 0.8 mg/day, increasing to 7.5 mg/day. Risk groups to develop anemia in pregnancy & Postpartum are showed in Table 1 below (Breymann, 2015).

Table 2 Risk groups to develop anemia in pregnancy & Postpartum

Pregnant women	Postpartum
- After 1st trimester	- High blood loss at delivery
- Multiple pregnancies	- Poor socio-economic status
- Short recovery between pregnancies	- Poor nutritional status
- Poor socio-economic status	
- Poor nutritional status	

In the field of Obstetric and Prenatal Care, anemia is a frequent problem. No matter the age of gestation, all haemoglobin less than 10.25 g/dL are considered as true anaemia (Breymann, 2015). The most common etiological factors associated with this condition are iron and folate deficiency (Lee and Okam, 2011; Horowitz *et al*., 2013). Anemia of pregnancy frequently severe in developing country. The hemoglobin value of 20% pregnant women in this country was estimated less than 8 g/dL, and 7% have a value of less than 7 g/dL. Due to blood loss during labor and in the puerperium, the condition becomes worse during the post-partum period. Peripartum blood losses of greater over 500 mL are typical, even in contemporary obstetrics. According to the American College of Obstetricians and Gynecologists, 1000 mL or more of blood is lost during delivery in 5% of women who give birth (Breymann, 2015).

Beside iron deficiency, many conditions can result in anemia during pregnancy. These include anemias caused by parasitic illnesses like hook worm and malaria, anemias caused by red cell disorders like thalassemia and sickle cell disease, and anemias caused by other nutritional deficiencies like folic acid and vitamin B12 deficiency (Breymann, 2015).

Anemia is linked to 40% of maternal mortality globally, according WHO data (Milman, 2011). The clinical effects of pregnancy-related anemia are strongly related to the underlying anemia's source. In this regard, it is challenging to say whether the hazards to the mother and the baby are due to the anemia alone or to the anemia's underlying causes. As a result, issues related to anemia brought on by iron deficiency are distinct from those related to anemia brought on by a mother's haemoglobinopathy. The consequences of of anemia in pregnancy are fatigue, exhaustion, weakness, "less energy" ; Cardiovascular symptoms (e.g.

palpitations) ; Pallor, pale mucous membranes and conjunctivae ; Tachycardia, Hypotension ; and Cardiac hypertrophy in chronic cases.

Anemia is associated with maternal mortality, i.e. every 1 g/dL rise in hemoglobin, the risk of maternal mortality decreased significantly. It was reported by CHERG study on iron deficiency (Murray, 2012). Anemia in pregnant women also linked to fetal risk. Maternal hemoglobin levels and birth weight are correlated in a U-shaped pattern. A 2-3 times increased risk of a neonate who is too light for their age is connected with hemoglobin levels of more than 11.0 g/dL and less than 9.0 g/dL. A lack of plasma volume expansion is likely to be the cause of pre-eclampsia risk and intrauterine growth retardation that is linked to hemoglobin levels of more than 12.0 g/dL at the end of the second trimester. Premature births (PMB), intrauterine growth retardation (IUGR), and intrauterine fetal death (IUFD) are all more likely in mothers whose hemoglobin levels are below 9.0 g/dL (Murray, 2012; Allen, 1997; Breymann, 2002; Kaltreider and Kohl, 1980; Rao and Georgieff, 2002; Rondo and Tomkins, 1999; Scholl and Reilly, 2000; Sifakis and Pharmakides, 1999).

Prevention and Therapy of anemia in pregnancy

The iron consumption which is recommended by most of guidelines were about 15 mg/day (to about 30 mg/day). For non-anemic and non-iron deficient women, this supplementation recommendation is adequate. To lower the risk of low birth weight, maternal anemia, and iron deficiency, daily oral iron and folic acid supplementation is advised as part of prenatal care, according to WHO recommendations (WHO, 2012). For avoiding anemia at term, intermittent iron supplementation (one to three times per week) seems to be just as beneficial as daily supplementation and is more well tolerated. An extra iron supplement of 30 to 120 mg per day should be given to women who have iron deficiency anemia (first or third trimester hemoglobin [Hb] 11 g/dL or second trimester Hb 10.4 g/dL with low serum ferritin) until the anemia is resolved (Breymann, 2015).

The need to treat anemia and iron-deficiency conditions appears obvious to the majority of practitioners. Maternal and fetal risks rise when anemia gets worse, even in milder types where it is sometimes hard to forecast how the illness will develop or whether it is likely to get worse. Several factors include the time left before delivery, the severity of anemia, additional risks (such as early labor), maternal co-morbidity, and the patient's own preferences (such as refusing to receive donor blood to treat severe anemia), are all things to consider when choosing the best factors of anemia treatment. Currently, oral iron, parenteral iron, growth factor stimulation of hemopoiesis (such as recombinant human erythropoietin), and delivery of heterologous blood are the major treatments for anemia (Bashiri *et al*., 2003; Breymann, 2002; Huch and Huch, 1994; Koenig *et al*., 1993; Krafft *et al*., 2009; Muñoz *et al*., 2008).

The gold standard for treating mild to severe iron deficiency-anemia is oral iron. However, this treatment had side effects such as constipation, heartburn, and nausea, which can affect up to 50% of patients (Hidalgoa *et al*., 2003). The dose must be lowered if these side effects occur, or an alternative product must be tried (Khalafallah and Dennis, 2012).

Nutritional Value of Beetroot (*Beta vulgaris L.*)

Chukander is another name of beetroot (Beta vulgaris). It is naturally belongs to the Chenopodiaceae family as a herbaceous biennial. According to popular belief, beets first appeared in early middle Bronze Age Egypt. Essentially, it is a winter season crop that is

grown by many people worldwide. However, the red color variant is the most well-known for human consumption. Beetroot is used to make a variety of products, including snacks, jams, and jellies, that are marketed all over the world (Chaudhary and Shaikh, 2020).

Beetroot contains contains Vitamin A, B, and C and a variety of minerals including calcium, magnesium, copper, manganese, iron, and phosphorus (Chaudhary and Shaikh, 2020). Vitamin B9 (folate) is one of the B vitamin that important for normal cell and tissue growth (Feketek *et al*., 2012). It helps to protect a newborn from neural tube defects. Therefore, beetroot is a part pregnant women diet recommendation (Helga, 2005). The iron content of beetroot also plays an important role in the human body. It transports oxygen to red blood cells, so it helps to cure anemia. Beetroot is also effective in treating a wide range of illnesses, including blood pressure, inflammation, cancer, heart disease, and skin issues (Chaudhary and Shaikh, 2020).

Effectiveness of Beetroot to Prevent and Cure anemia in Pregnancy

The identical intervention (beet juice) was administered to pregnant women in trimester III by Khairiah *et al.* (2022) and Lestari *et al.* (2022), however their patients came from different hospitals. At Budhi Asih Hospital, administering beetroot juice to third-trimester pregnant patients increases hemoglobin levels significantly, with a p value ≤ 0.05 (Khairiah *et al.*, 2022). The Dina Karya Medan Clinic patients' studied by Lestari *et al*. (2022) yielded the same conclusion. The findings demonstrated that betroot juice may considerably increase hemoglobin levels, enabling third-trimester pregnant women to use it to prevent anemia. Beetroot contains 34% folic acid, which helps to grow and replace damaged cells, avoid birth defects, and assist fetus brain development in third trimester pregnant women. Beetroot tubers also contain iron. It can be used to raise blood iron levels in anemic patients (Lestari *et al*., 2022).

Beets were compared to other vegetables, such spinach, to demonstrate their effectiveness in treating anemia in pregnant women. Beets and spinach were given to 18 pregnant women at the Pratama Kasih Bunda clinic for this study, effectively raising hemoglobin levels (Istiqomah and Fauzi, 2022). Beets also combined with lemon to demonstrate the efficacy of treating anemia in pregnant women. Addition of lemon purpose to reduce the unpleasant aroma of beet juice. This intervention was given to 14 pregnant woman with anemia in Wonorejo Village, Pringapus Public Health Service working area. The result showed that administering Fe tablets together with beet root and lemon juice increased hemoglobin levels in pregnant women with anemia effectively (Setyiyaningsih, Widayati and Kristiningrum, 2020). Consuming beetroot juice together with ferrous sulfate tablet was also effective increasing hemoglobin levels in mild anemic pregnant women in sub-district of Darul Imarah, Aceh Besar (Sakdah and Idiana, 2022). This study is comparable to that by Risnawati, Indanah, and Sukesih (2021). At the Tayu I Health Center, pregnant women with anemia were able to increase their hemoglobin levels by consuming beetroot juice along with an iron supplement.

In vivo experiment was did by (Zakiyah and Setyaningsih, 2019). In this investigation, the effectiveness of beetroot juice and iron supplementation in treating anemia in 20 pregnant female rats was compared. The result showed that beetroot juice was proven as an alternative product for handling anemia in pregnant female rats. Two last study were

investigated the potential of beetroot in anemic Post-partum Women. The first study was compared the effects of beet juice and guava juice on postpartum mothers' erythrocyte and hematocrit (HTC) levels at Darul Imarah Health Center in Aceh Besar District. The results showed that Beet juice increases the average erythrocytes and HTC levels higher than guava juice. The differences of erythrocyte and HTC levels between before and after guava and beets juices administration also significant with a p-value of 0.00 <0.05 (Nurhasanah *et al.*, 2021). The second study was administered beetroot as an ice cream. The results of the study showed that after receiving a 7-day administration of 11 g of beetroot ice cream and Fe tablet supplementation, anemic post-partum women's hemoglobin levels increased.

Increasing hemoglobin level after consuming beetroot during pregnancy demonstrates that treating anemia in pregnant women can be accomplished non-pharmacologically in addition to pharmacologically. Beetroot act by stimulating the circulatory system and assisting in the production of red blood cells because it contains include folic acid and vitamin B12, which are essential for cellular metabolism and required for the regular formation of erythrocytes (Geisser and Burckhardt, 2011).

CONCLUSION

Beetroot has the potential to prevent and treat anemia in pregnancy by increasing hemoglobin levels and the amounts of hematocrit. It contains high level of folic acid which is important for normal cell and tissue growth. The iron content of beetroot also plays an essential role in the human body to transport oxygen to red blood cells, so it helps to cure anemia. Further research is needed to find out how much beetroot is needed for the prevention and treatment of anemia effectively. Moreover, the toxicity and content of active compounds in beets are also needed to ensure the efficacy of beets. Expression of genes related to the effect of beetroot on anemia is also needed to ensure the mechanism of beetroot in controlling anemia.

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