



Review on *Katuk* (*Sauropus androgynus* (L.) Merr.) and Milk Production of Breastfeeding Mothers in Indonesia

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Abstract. *Katuk* (*Sauropus androgynus* (L.) Merr.) leaf and its products, culturally have been used by lactation mothers in Indonesia to improve their milk production. A limited study examined the different processing/serving of the leaf to the milk releasing. This study aimed to explore the effectiveness of *katuk* leaves on the milk production of breastfeeding mothers based on studies conducted in Indonesia. A literature review was performed on 6 studies selected through 2 Indonesian article search engines, Garuda (garuda.kemdikbud.go.id) and Indonesia One Search (onesearch.id) for the period of 2016-2021. Keywords used for the selection were *katuk* leaf, breast milk production, nursing mothers, and *Sauropus androgynus*. The inclusion criteria for the selection of the articles were an experimental study in breastfeeding mothers, full text written in Indonesian or English, and published in a journal indexed by Scopus 1-4 or by Indonesian journal indexation, Sinta 1-4. All the studies in this review reported that supplementation of *katuk* leaf in the form of extract capsules, *katuk* boiled water, and *katuk* biscuits significantly increase the milk production of healthy breastfeeding mothers. Two studies reported an increase in the baby's weight and the mother's prolactin hormone, respectively. The milk production of breastfeeding mothers who consumed the *katuk* leaf was reported better than those who did not consume the leaf with a majority of p-value 0.000.

Keywords: Breast Milk Production, Katuk Leaf, Mothers, Sauropus Androgynus.

1 Introduction

Breast milk is the ideal food for babies because it is natural and contains nutrients that are useful for a baby's growth and development. In Indonesia, breastfeeding behavior has become a culture, but the practice of breastfeeding is still far from being expected. The national exclusive breastfeeding (EBF) coverage was around 37.5% [1], while the Indonesian government target is 60% by 2024 [2]. Continued breastfeeding at 2 years has been reported less practiced in mothers with college educational backgrounds than those with no or low education backgrounds [3], but in general, both groups are under the EBF target [4], with the common reason is insufficient milk volume [Error! Bookmark not defined.,5].

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The milk ejection is started by the baby's sucking on the mother's nipple. Once the suckling began, it will promote production of prolactin hormone which regulates cells in the alveoli to produce milk. Baby's sucking also stimulates the production of oxytocin hormone which induces the contraction of myoepithelial cells surrounding the alveoli to push milk releasing. Hence, the more often the baby sucks the mother's nipple, the more milk production will increase, and vice versa; if the mother stops breastfeeding, the milk production will decrease [6,7].

Katuk (*Sauropus androgynus* (L.) Merr), also known as star gooseberry or sweet leaf or phak wan ban or chakrmanis is a tropical plant widely traditionally known by Indonesian mothers to improve breast milk volume [8] by increasing prolactin and oxytocin [9] and providing essential nutrients [10-12]. The plant has many other names in many areas in Indonesia, e.g., kebing and katukan (Java), simani (Minangkabau), kerakur (Madura), and katuk (Sunda). Katuk leaf has many active compounds e.g., glycosides, saponins, tannins, sterols, alkaloids, and high content of fatty acids, polyphenols, and flavonoids as the major bioactive components [Error! Bookmark not defined.,13] and numerous pharmacological activities e.g., antioxidant, anti-inflammatory, and anti-obesity [Error! Bookmark not defined.]. The polyphenolic compounds play a role in releasing prolactin hormone, while sterol compounds are estrogenic which play increase breast milk production. Currently, there is a growing number of studies assessing the effectiveness of katuk leaves in Indonesia. Previous studies conducted in Indonesia have reported the association between the consumption of katuk leaves and the improvement of milk production of breastfeeding mothers [14-18]. They served the katuk as a part of the main menu, source of vegetables [Error! Bookmark not defined.], katuk stew [Error! Bookmark not defined.], and capsule supplementation [Error! Bookmark not defined.,Error! Bookmark not defined.,Error! Bookmark not defined.]. Limited data are available to review the effectiveness of this katuk supplementation form. The aim of this study was to explore published studies about the effectiveness of katuk leaf consumption on the breast milk production of breastfeeding mothers in Indonesia.

2 Methods

A literature review known as critical review of knowledge, ideas, or findings contained in the literature [19] was performed to explore the effectiveness of katuk leaf consumption on breast milk production. The articles were selected using 2 Indonesian research databases namely Garuda (garuda.kemdikbud.go.id) and Indonesia One Search (IOS) (onesearch.id) with keywords katuk leaf, breast milk production, nursing mothers, and *Sauropus androgynus* for the period of 2016-2021. The inclusion criteria for selecting articles were experimental study in breastfeeding mothers, full-text written in Indonesian or English, and the articles published in journals indexed by Scopus (Quartile 1-4) or by Indonesian journal indexation, Sinta 1-4. Based on these criteria, there were 6 studies [Error! Bookmark not defined.,Error! Bookmark not defined.,Error! Bookmark not defined.,20-22] included in this review; 2 articles were identified from

the Garuda database, and 4 articles were obtained from the One Search database (Fig. 1).

3 Results

Most of the studies conducted in the community health services [Error! Bookmark not defined.,Error! Bookmark not defined.,Error! Bookmark not defined.,Error! Bookmark not defined.] with the number of participants was varied from 20 to 60 healthy breastfeeding mothers and babies (Table 1). An experimental study with a pre-post control group design was used in all the selected articles with a variation of *katuk* administration types, and doses, including *katuk* leaves extract capsules (1-3 capsules/day) [Error! Bookmark not defined.,Error! Bookmark not defined.,Error! Bookmark not defined.,Error! Bookmark not defined.], *katuk* stewed in water [Error! Bookmark not defined.,Error! Bookmark not defined.], and *katuk* biscuits [Error! Bookmark not defined.]. The duration of administration of the *katuk* intervention was varied from one week until 3 months with the outcomes measured by an increase in the mother's milk production through an observation [Error! Bookmark not defined.,Error! Bookmark not defined.,Error! Bookmark not defined.], baby's weight [Error! Bookmark not defined.], and prolactin secretion [Error! Bookmark not defined.,Error! Bookmark not defined.]. Seventy percent mothers who consumed 2 *katuk* extract capsules/day reported increasing their milk production compared to those without taking the *katuk* capsules of 6.7% improvement [Error! Bookmark not defined.]. An increase in serum prolactin was found higher in the intervention group that consumed *katuk* extract capsules and *katuk* biscuits than in the control group without *katuk* administration [Error! Bookmark not defined.,Error! Bookmark not defined.]; however, the increase in prolactin was not associated with the improvement of baby's development [Error! Bookmark not defined.]. All the studies reported significant positive effects of the administration of *katuk* leaves and the mother's breast milk volume compared to the control groups without taking the leaf (the majority of *p*-values were 0.000) (Table 2).

Articles filtered by keywords and year:

n=17 articles (Garuda page)

and n=18 articles (One Search page)

Matched articles based on the inclusion criteria:

n= 6 articles (Garuda page)

n=4 articles (One Search page)

Excluded articles due to did not match the inclusion criteria:

n=11 (Garuda page)

n= 10 (One Search page)

Excluded articles due to did not indexed by Sinta 1-4 or Scopus:

n=2 (Garuda page)

n= 2 (One Search page)

Fig. 1. Studies selection diagram

Table 1. Studies Location and Respondent Characteristics

Authors	Study locations	Respondents	Number of respondents	
			Intervention (n, age)	Control (n, age)
Siti Aminah <i>et al.</i> , 2019 [Error! Bookmark not defined.]	Community health service, Sukorame, Kediri	Breastfeeding mother age 0-40 days.	16 (n/a)	16 (n/a)
Suwanti & Kuswati, 2016 [Error! Bookmark not defined.]	Midwife practice in Klaten area	Breastfeeding mother with normally newborn and healthy.	15 (n/a)	15 (n/a)
Nurjanah <i>et al.</i> , 2017 [Error! Bookmark not defined.]	Wonokromo district	All mothers who have consuming moringa extract capsules.	18 (n/a)	6 (n/a)
Juliastuti, 2019 [Error! Bookmark not defined.]	Community health service, Kuto Baro Aceh	Exclusive breast-feeding mother with healthy baby age 0-28 days, do not working/taking medicine/have physical problem on their breast.	10 (20-35 y)	10 (20-35 y)
Van Gobel & Mobilu, 2019 [Error! Bookmark not defined.]	Hospital in Dunda Limboto	Post-partum mothers with normal delivery their baby.	30 (16-45 y)	30 (16-45 y)
Indrayani <i>et al.</i> , 2020 [Error! Bookmark not defined.]	Community health service PONEB, Bandung	Mothers who gave birth for the first time (primiparous), did not use other drugs to increase milk production, exclusively breastfed their babies, their babies were full-term, single babies, healthy, and birth weight babies around ≥ 2500 grams.	22 (17-28 y)	23 (16-28 y)

Note: n/a, not available

Table 2. Dose, Frequency and the Duration of Administration Katuk Leaves on Breast Milk Productions

Authors	Research design	Duration (Days)	Treatment groups		Control groups		p-value ^b
			Type, dose or frequency	Indicator of milk production	Type, dose or frequency	Indicator of milk production	
Siti Aminah et al. [15]	Pre experiment, one group pre-post test design, purposive sampling.	7	100 g of katuk leaves stewed in 300 cc water	93.8% reported increasing the milk production	100 g or 8 dates	50% reported increasing the milk production	Mann-Whitney test (0.007)
Suwanti & Kuswati [17]	Quasi experiment with pre-post control group design, quota sampling.	30	2 katuk leaves extract capsules, twice	70% reported more produced milk, no negative side effects reported	Without intervention	6.7% reported more produced milk	Chi-square test (0.002)
Nurjanah et al. [18]	Quasi experiment with post-test only control group design, simple random sampling.	90	Katuk leaves extract capsules: - G1: once - G2: twice - G3: 3 times	Means±SD prolactin hormone (mg/mL) - G1/d-30=9.7±1.71 - G2/d-60=13.68±10.46 - G3/d-90=17.65±8.35 Baby's development: - G1=2.2±6.80 - G2=2.7±7.61 - G3=2.8±8.06	G4: no katuk extract capsules	Means±SD prolactin hormone (mg/mL) d-30=4.7±10.23 Baby's development= 1.3±5.48	One-way anova & Post-hoc LSD (0.000 ^c)
Juliastuti [20]	Quasi experiment with pre-post control group design, purposive sampling.	7	Katuk stew	Mean increase in baby's weight= 259 g	Katuk extract capsules	Mean increase in baby's weight= 182 g	Independent T-test (0.000)
Van Gobel & Moberliu [21]	True experiment with control group design, concecutive sampling.	14	Combination of oxytocin message, marmet techniqued and consume 300 mg katuk leaves extract tablets 3 times.	Frequency of giving breast milk by questionnaire: effectively increased milk production.	Without intervention	n/a	Kruskal Wallis (0.000)
Indrayani et al. [22]	Randomized control trial (RCT) design, block randomization sampling technique.	14	One packet katuk leaves biscuits containing 9 biscuits.	Serum prolactin level (ng/mL) by ELISA at 8-10 am Pre=139.7 Post=149.1 Δ pre-post=9.37	Consume biscuits	Serum prolactin level (ng/mL) by ELISA Pre= 143.3 Post= 118.5 Δ pre-post = - 24.73	Independent T-test 0.394 0.019 0.032

Note: n/a, not available

- p-value before and after intervention in each group.
- p-value between treatment and control group.
- Dose twice and 3 times per day had significant effect on the prolactin hormone and the baby's development score; the increase in mothers' prolactin hormon did not affect on the improvement of the baby's development.

- d. Oxytocin massage was done by massaging the mother's back on the side of the vertebra until scapula (costa 5-6) based on the oxytocin massage procedure on day 1-3; marmet technique was performed by combination of milking and massaging based on the marmet technique procedure standard on day 1-3 to help reflects key of releasing breast milk.

4 Discussion

All the studies involved in this review reported significant positive impacts supplementation of katuk leaves in the form of extract capsules, moringa stew, and moringa biscuits on the mother's milk production. This evidence are consistence with studies examining the mechanical of katuk leaf in milk synthesis. Katuk is a natural galactagogue, the lactation-stimulating substance which commonly used as a natural breastmilk booster with minor side effects on the mother and the baby compared to conventional galactagogues/drugs [Error! Bookmark not defined.,23].

The increasing milk production after consuming plant galactagogue have been reported in an animal study using Wistar rats [24]. The study reported that a mixed herbal galactagogue containing *Sauropus androgynus* (L.) Merr., *Trigonella foenum-graceum* L. (klabet seeds or fenugreek), and *Moringa oleifera* Lam (locally named kelor) significantly increased milk production of the lactating rats through upregulation of α -lactalbumin, and aquaporin genes expression at the messenger ribonucleic acid (mRNA) level in the mammary glands [Error! Bookmark not defined.]. α -lactalbumin is a whey protein that has a key role in lactose biosynthesis and the formation and secretion of the water phase of milk. It interacts with β -1,4-galactosyltransferase-I to modify its specificity so that it can catalyze the formation of glucose from galactose (lactose synthesis) [25]. Aquaporins are membrane protein water channels that are crucial for water flux regulation across the cell membranes and controlling water homeostasis. A review study reported that several aquaporin proteins interact in milk production in the mammary glands [26].

In Indonesia, katuk has been widely known and believed by the community for increasing breast milk production with no side effects reported; most of the breastfeeding mothers (both new mothers and older) quite know well about the benefits of katuk [Error! Bookmark not defined.]. The leaf can be found in traditional markets or supermarkets or planted in the house yard, and are easily prepared as fresh vegetables or cooked (e.g., boiled or stewed or stir fry) for daily menu during pregnancy and lactation, but the majority of mothers prefer to consume it during the first month of lactation [Error! Bookmark not defined.]. Excessive consumption of the uncooked katuk leaf has been associated with bronchiolitis obliterans [Error! Bookmark not defined.].

In terms of the outcomes reported in the studies in this review, increasing the baby's weigh is the best indicator to measure the sufficient milk during the early neonatal period [Error! Bookmark not defined.]. On the first day or 24 h postpartum, milk volume increased rapidly and constantly after a month postpartum of about 750-800 mL/day, depending on the breastfeeding frequency and milk consumed by the baby [Error! Bookmark not defined.]. An efficient baby's sucking of the mother's nipple will optimize responses to centre nervous system to produce prolactin and oxytocin

hormones which regulate milk production. Supplementation of katuk leaf extract significantly increases the prolactin hormone in breastfeeding Wistar rats [27]. Another study reported increasing expression of prolactin and oxytocin genes in lactating mice after fed diets containing both young and mature katuk leaf extract, respectively [28].

5 Conclusion

All the studies in this review reported that supplementation of katuk leaf in the form of extract capsules, katuk boiled water, and katuk biscuits significantly increase the milk production of healthy breastfeeding mothers. Two studies reported an increase in the baby's weight and the mother's prolactin hormone, respectively. The milk production of breastfeeding mothers who consumed the katuk leaf was reported better than those who did not consume the leaf with a majority of p-value 0.000.

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Conflict of Interest. The authors have no conflicts of interest to declare.

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