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Review Article

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Use of local herbal galactagogues by Nigerien women to enhance breast milk production

Maman Manzo Lawaly[1,2]*, Khalid Ikhiri[3]

[1]Faculty of Agriculture and Food Technology, University Boubakar Bâ of Tillabéri, Tillabéri, Niger, [2]Department of Nutrition and Dietetic, University Institute of Technology, Tillaberi, Niger, [3]Department of Chemistry and Natural products, University Abdou Moumouni of Niamey, Niamey, Niger

ABSTRACT

Breastfeeding is recognized as an effective way to save children's lives. Nigerien breastfeeding mothers with insufficient milk production traditionally use medicinal plants to enhance milk yield, despite of absence of scientific reports confirming the evidence-based safety and efficacy of these practices. The aim of this study is to review the ethnomedicinal knowledge about the use of medicinal plants to promote lactation in breastfeeding mothers by Nigerien peoples, and to assess their evidence-based toxicological and chemical studies reported across the world. Relevant data about the plant species used to promote lactation were extracted from published or unpublished valuable reports of ethnobotanical surveys conducted in Niger for a comprehensive review. Six studies were reviewed. A total of thirteen (13) plant species belonging to 11 families were recorded as being used as galactagogues by Nigeriens. This review poined out three species including *Sclerocarya birrea*, *Caralluma longidens* and *Guiera senegalensis* to be the most cited. Using plants to promote lactation in breastfeeding mothers is a very common practice in Niger republic. However, there are no scientific reports based on laboratory studies which could justify the rational use of these plants. Further local studies are urgently needed to confirm the efficacy and safety of these plants.

KEYWORDS: Breastfeeding, Galactagogue, Medicinal plant, Phytochemicals, Toxicity, Niger

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***Corresponding author:**
Maman Manzo Lawaly
E-mail: lawaly.manzo@gmail.com

INTRODUCTION

Breastfeeding is the best means to provide proper a meal for healthy infant growth and development. It is an integral part of maternity and has clear benefits for the mother's health. For direct impact on growth, development, and health, the infant should be breastfed within the first hour of birth and should be exclusively breastfed during the first six months of life: this is a key public health recommendation from the World Health Organization (WHO) (Hoddinott *et al.*, 2008). Exclusive breastfeeding is the intervention that has been estimated to be the most effective compared to its cost to prevent mortality of children under 5 years old (Ihudiebube-Splendor *et al.*, 2019). In 2012, the World Health Assembly set the goal to increase the rate of exclusive breastfeeding over the first six months to at least 50% by 2025 (World Health Organization, 2014).

In Niger republic, malnutrition problems begin early in life, mainly during the first two years (Lawaly *et al.*, 2023). Indeed, feeding practices among infants and young children are not the best in Niger and constitute, with morbidity, one of the important factors of the nutritional status of children. To date, breastfeeding is recognized as an effective way to save children's lives. Various national health policies and strategies including action plans from national and international programs have been developed around three key breastfeeding practices: (i) introduction of breastfeeding in the first hour after birth, (ii) exclusive breastfeeding until 6 months after birth and (iii) continued breastfeeding with complementary foods until at least 24 months of age (Gouvernement de la République du Niger, 2013; Victoria *et al.*, 2016). A national level survey on health which was conducted in 2006, reported that almost all children are breastfed (98%) and this practice is maintained for a median period of approximately 21 months (Institut National de la Statistique, 2007). For exclusive breastfeeding and despite all efforts from the government and other non-government organizations, the rate over the six first months has regressed from 23.3% with its median duration being 1.1 months in 2012 (Institut National de la Statistique, 2013) to 21.8% in 2022, rates that are much lower than the minimum 60% recommended by the WHO and UNICEF (WHO & UNICEF, 2017). Hitachi *et al.* (2019) in a previous community-based cross-sectional study conducted in Niger have investigated the association between various factors and exclusive breastfeeding. Findings

from this study suggest that factors such as prelacteal feeding, problems with delivery, low socioeconomic status, and early initiation of breastfeeding and delivery assistance by a traditional birth attendant were associated with exclusive breastfeeding. Thus, to resolve most problems related to milk supply and socioeconomic status which could help buy conventional drugs intended to resolve lactation insufficiency, mothers are tempted to try complementary medicine (traditional medicines) as an alternative.

Lactation Insufficiency

Lactation is a discontinuous biological function specific to women and intended to adapt the newborn to independent life. It is determined by human being proper characteristics, both in terms of the anatomy of the breast, the physiology of human lactation, the sucking mechanism, the maintenance of lactation and the constituents of breast milk (Figure 1). Adequate or sufficient milk production in mothers is detrimental for infant growth, development and better health (Kramer & Kakuma, 2012). Lactation insufficiency in many postpartum women can be related to primary or secondary causes. Agalactia or complete absence of milk production is a primary cause related to anatomic breast abnormalities or hormonal aberrations. Hypogalactia or inadequate milk production is a secondary cause associated with problems in breastfeeding management (Neifert, 2001; Liao *et al.*, 2024).

Factors such as insufficient mammary tissue (Amir *et al.*, 2014), hormonal imbalances (Hill *et al.*, 2009), inadequate diet (Farah *et al.*, 2021), and ineffective milk removal from the breast, excess body fat, gestational diabetes, higher caesarean section delivery rates, stressful labor lasting more than an hour, and other complications were reported to cause lactation insufficiency (Lee & Kelleher, 2016; Riddle & Nommsen-Rivers, 2017; Nommsen-Rivers *et al.*, 2022; Monika *et al.*, 2023; Ryan *et al.*, 2023).

Pharmacological and Natural Galactagogues

Traditional or modern alternatives are solicited by most breastfeeding women who are concerned about their milk supply in an attempt to boost the production of sufficient milk for their infant. In most cases, pharmacological measures which involve the use of galactagogues are implemented as therapies to facilitate increasing milk supply (Hofvander, 2005; The Academy of Breastfeeding Medicine Protocol Committee, 2011; Hussain *et al.*, 2021). Galactagogues can be synthetic agents or natural products which are respectively prescribed by modern and traditional practitioners (Gabay, 2002; Shen *et al.*, 2021). Synthetic galactagogues such as metoclopramide, oxytocin, domperidone and chlorpromazine were significantly reported to have potential side effects on the central nervous system, cardiac arrhythmias (Paul *et al.*, 2015; Zizzo *et al.*, 2021) and weight gain (Jolliet *et al.*, 2007; Zuppa *et al.*, 2010). Therefore, in search for more acceptable, safe and efficacious alternatives, mothers are opting for traditional medicine, particularly which involve the use of herbal galactagogues to initiate, maintain or enhance breast milk production (Budzynska *et al.*, 2013; Sim *et al.*, 2015). Medicinal plants have been used by many breastfeeding women to promote lactation by generations of women in various parts of the world (Turkyılmaz *et al.*, 2011; Özalkaya *et al.*, 2018). In the present study, we focus on medicinal plants that are used to promote lactation among breastfeeding mothers in Niger republic.

Methodology

The ethno-botanical/ethno-medicinal surveys were reviewed for medicinal plants with claimed traditional usages to enhance lactation in breastfeeding mothers in Niger republic. Searching approaches include: (i) search for valuable unpublished research reports (BSc/MSc/PhD) using the Google search engine and regional or local university and research institute websites; (ii) search for published original research papers using online international scientific databases platforms like Google Scholar, AJOL, HINARI, etc. Full-text literatures written in French

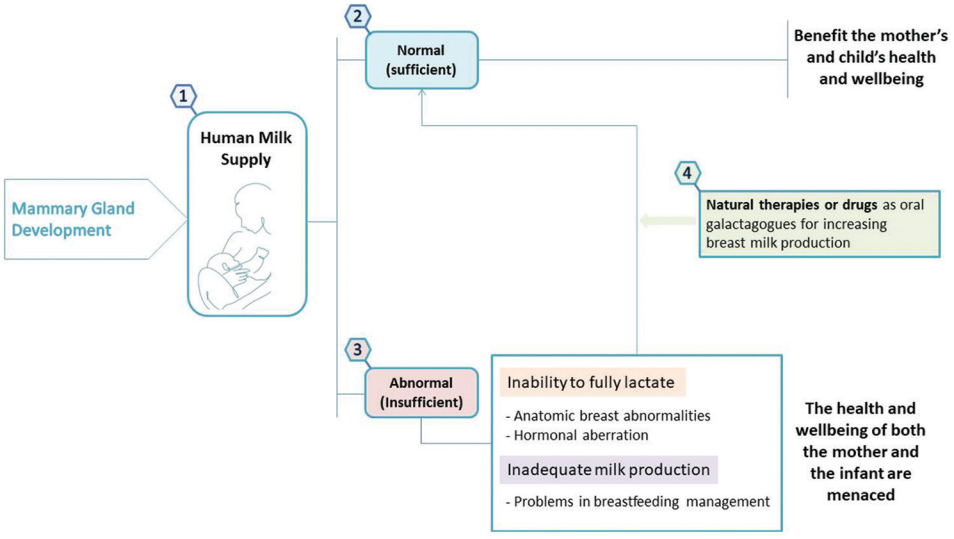

Figure 1: Lactation insufficiency in breastfeeding mother: related factors and consequences. The figure was adapted from (Christian *et al.*, 2021)

and English languages were considered. Then, the traditional knowledge or practices of the selected plant remedies were confronted to existing in vitro, preclinical and/or clinical studies of evidence-based studies of the above mentioned uses and their respective safety. Other valuable preclinical and clinical studies involving other plant remedies as galactagogues which are reported elsewhere (in other countries) were also mentioned for the purpose of data discussion. Phytochemical constituents and safety were also mentioned for reference.

RESULTS

Ethnomedicinal Review of Plants used to Promote Lactation

Our search resulted in a total of 17 studies among which 06 were considered for the purpose of this literature review. A total of 13 medicinal plants belonging to 11 families were reported to be used by Nigerien breastfeeding mothers to promote lactation. Medicinal plant species belonging to the family Fabaceae (3 species) were found as most commonly used. Table 1 presents a summary of the most commonly reported medicinal plants indicated for the promotion of lactation in breastfeeding mothers.

Parts of the Plant used and Modes of Preparation

Up to seven different plant parts (leaves, bark, root, stem, seed, flour and the whole plant) were found to be used by breastfeeding mothers to promote lactation. The highly utilized part were leaves (29%), roots (20%), stems (18%) and flours (12%) (Figure 2). Only three studies have reported the modes of preparation of the plant species with decoction as the predominant method followed by powder.

DISCUSSION

The present review of most valuable ethnobotanical surveys that were conducted in Niger republic reemphasizes that inhabitant of various parts of the country, especially women, use plants to promote lactation. While advices for natural galactagogues are often influenced by familiarity and local customs (Foong *et al.*, 2020).

In total, nineteen plant species were reported to be widely used for the enhancement of lactation in breastfeeding women. Only two plant species (*G. senegalensis* and *Acacia nilotica*) out of seventeen were recorded to be utilized for the same indication in other sub-Saharan countries including Burkina Faso (Lompo-Ouedraogo *et al.*, 2004), and Nigeria (Garba *et al.*, 2015; Aminatu *et al.*, 2017). The family Fabaceae was the most cited for lactation promotion in various local communities in Niger republic and the commonly reported species were *Boscia salicifolia*, *G. senegalensis* and *S. birrea*. While the most commonly used plant parts are the leaves; followed by roots, flowers and stems. For chemical constituent estimations, leaves appeared to be the most studied plant part and this may be advantageous for biodiversity conservation strategies in efforts to fulfill the obligation of Chang Mai declaration of 1988 "Saving plants that save lives" (World Health Organization, International Union for Conservation of Nature and Natural Resources & World Wide Fund for Nature, 1993). Several reports have emphasized the richness of these plants in various chemical constituents which could be responsible for their biological activities as galactagogues. For instance, fenugreek was reported to have lactating properties due to their phytoestrogenic structures (flavonoids, terpenoids and saponins) (Turkyılmaz *et al.*, 2011). Isoflavones and their metabolites were reported to possess the ability to influence the milk production of mammary epithelial cells (MECs) through different interactions with prolactin/STAT5 signaling (Tsugami *et al.*, 2017). While most of these secondary metabolites could be toxic to body system when took without caution (Manzo *et al.*, 2019). Numerous studies have reported slight to deleterious side effects that could arise after the ingestion of certain medicinal plants in experimental animals. For instance, in a sub-chronic toxicity study, the leaf extracts of *G. senegalensis* were found to cause some signs of toxicity on

Table 1: Ethno-medicinal uses of plants to promote lactation

Plant species	Family	Plant part	Local name	Reference
Boscia salicifolia Oliv.	Capparidaceae	Seeds	Zuré (H), Shinkiliga (Z)	Khalid *et al.*, 1984; Baggnian *et al.*, 2018
Sclerocarya birrea (A.Rich.) Hochst.	Anacardiaceae	Leaves, Stem, Flour, Roots	Dania (H), Daney (Z)	Hamadou, 2008; Alexander, 2011
Acacia albida Delile	Fabaceae	Leaves, Stem, Bark, Flour, Roots	Gao (H), Kokoy×e (Z)	Alexander, 2011
Acacia nilotica (L)	Fabaceae	Leaves, Stem, Bark, Roots	Bagaruwa (H), Baani (Z)	
Adansonia digitata L.	Malvaceae	Leaves, Stem, Bark, Roots	Kuka (H); Koo Nya (Z)	
Balanites aegyptiaca (L.) Del.	Zygophillaceae	Leaves, Stem, Flour, Roots	Aduwa (H), Garbey (Z)	
Prosopis africana (Guill et Perr) Taub	Mimosaceae	Leaves, Roots	Kiryia (H), Zam-turi (Z)	
Caralluma longidens N. E. Br.	Asclepiadaceae	Whole plant	Haba haba (H)	Adam *et al.*, 1972;
Guiera senegalensis J.F. Gmel.	Combretaceae	Whole plant, Leaves, Stem, Flour, Roots	Shabara (H), Sabara (Z)	Alexander, 2011
Cucumis ficifolius' A. Rich.	Cucurbitaceae	Leaves	Yamanya (H)	Adam *et al.*, 1972
Tephrosia purpurea Linn. Pers.	Fabaceae	Leaves	Margwa (H)	Adjnohoun, 1980
Euphorbia aegyptiaca Boiss.	Euphorbiaceae	Leaves	Nono'n Kurtchia (H)	
Gisekia pharnacioides L.	Gisekiaceae	Whole plant	Gado'n mashijy (H), Takka chijla (Z)	

H-Haoussa; Z-Zarma

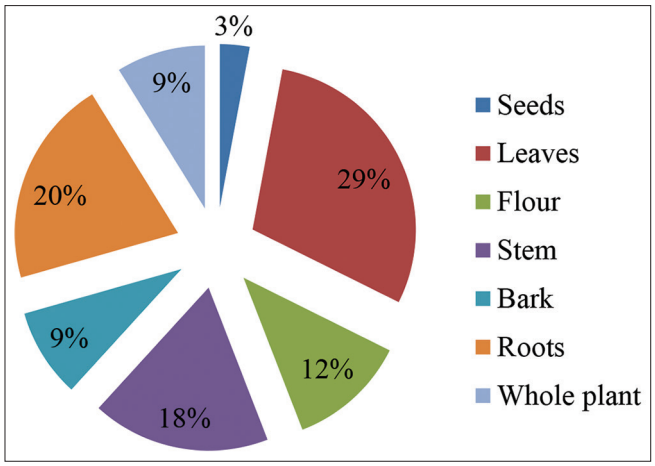

Figure 2: Proportions of different parts of the plant used as galactagogue

heart and some effects on the immune system (Umma *et al.*, 2023). Yahaya *et al.* (2022) investigated the hematotoxicity and nephrotoxicity of long-term administration of *G. senegalensis* in rats. Results showed that the kidneys of the rats fed with plant extract presented vacuolation of cytoplasm and tubular degeneration. Oluwakanyinsola *et al.* (2010) and Salawu *et al.* (2009) both reported some behavioral signs (salivation, rubbing of nose and mouth on the floor of the cage and restlessness) of toxicity in rats which have received extracts of different parts of *Faidherbia albida* at 2900 and 5000 mg extract/kg body weight. Mailafiya *et al.* (2022) conducted an evaluation of the in vivo and in vitro antidiarrheal effects of methanol leaf extracts of *B. salicifolia* in mice and isolated rabbit jejunum. Findings show that the plant extract is slightly toxic with LD50 value of 3800 mg/kg. Similarly, Moshi *et al.* (2006) evaluated the toxicity effects of *B. salicifolia* ethanol leaf extract in brine shrimp and found that the plant extract is toxic with LC50 value of 22.8 µg/L Muhammad *et al.* (2014) reported that the peels and seeds extracts of *S. birrea* are relatively toxic in exposed rats at doses of 3000 and 4000 mg/kg body weight. Thus, scientific evidence for the possible benefits and harms of plant remedies as galactagogues is important for health policy makers to best accompany breastfeeding mothers. Like almost all conventional drugs, certain herbal and traditional medicines transfer into breast milk and this may be harmful to a breastfed infant (Sachs *et al.*, 2013; Hotham & Hotham, 2015).

To produce scientific evidences which could support the efficacy of plant remedies in enhancing lactation, researchers across the world have conducted several laboratory-based studies on animal models in view to justify most traditional claims. In Burkina Faso, Lompo-Ouedraogo *et al.* (2004) determined the effect of aqueous leaf extract of *A. nilotica* on milk production in rats. Results showed that female rats that received oral doses during their first lactation produced about 59% more milk with a pup weight gain to be significantly higher than that in the control group. Stimulation of the synthesis and release of prolactin, clear lobuloalveolar development with milk secretion in the mammary glands of oestrogen-primed treated rats were also recorded. In Nigeria, Aminatu *et al.* (2017) investigated the effect of aqueous leaf extract of *G. senegalensis* for possible milk production in Wistar rats. Results showed that the plant extract have significant effect in enhancing milk production in rats, the increase in the amount of milk yield in grams per day in each group seem to drop at higher doses of 200 and 400 mg/kg body weight respectively. However, how the plant extract acts in increasing the level of prolactin or oxytocin was not investigated by the researcher. Garba *et al.* (2015) investigated the effect of feeding *G. senegalensis* leaves on intake and milk yield of lactating goats. Findings showed that inclusion of plant leaves in the diets of lactating goats does at 30% maintain milk yield compared to the control diet. Chonsut *et al.* (2023) investigated the effect of Tri-Than-Thip (Tri-TT), a Thai herbal medicine remedy, on milk production and determined if it has a galactagogue effect. Findings revealed a significant increase in total milk production among lactating female Wistar rats treated with 500 mg/kg of Tri-TT, compared to the control group. A larger alveolar diameter of the mammary gland in comparison to the control group was also observed, thereby facilitating increased milk volume. Zhang *et al.* (2021) explored the lactogenic effect and underlying molecular mechanism of raw *Hordei Fructus Germinatus* on rats with overloaded lactation. Findings showed that raw *Hordei Fructus Germinatus* effectively enhances lactation in rats, possibly by influencing the prolactin/JAK-STAT signaling pathway. Koko *et al.* (2019) investigated the galactagogue effect of *Euphorbia hirta* aqueous leaf extract on milk production in female Wistar Rats. Findings showed that the plant extract induces an increase of milk production in lactating rats and the action was stronger at the dose of 200 mg/kg with a significant increase of the biosynthesis of prolactin and the development of the lobuloalveolar system of the mammary glands in treated female rats. In a similar study, Doukouré *et al.* (2023) evaluated the effect of *E. hirta* whole plant aqueous extract on milk production in adult Wistar female rats. Results showed that the extract significantly induces an increase of milk yield in treated rats compared to blank and reference controls. The author hypothesized that the stimulation of milk production in mammalian could be attributed to the richness of *E. hirta* in several phytochemical compounds.

Few clinical studies of plant-based galactagogues were conducted across the world. In an intervention review published in the *Cochrane Database of Systematic Reviews*, Foong *et al.* (2020) reported the evidence from randomized controlled studies. Twenty-seven studies compared natural oral galactagogues with placebo or no treatment, one study reported breastfeeding rates at six months with a concluding statement of "no significant difference" and three studies reported infant weight. Possible harms that were listed with respect to natural oral galactagogues under investigations include: (i) loose stools, may be allergenic for some people; seeds may increase risk of sun burn (leaf of *Medicago sativa*), (ii) possible allergen for some people (fruit of *Pimpinella anisum*; aerial parts of *Cnicus benedictus*; fruit of *Carum carvi*; leaf and root of *Taraxacum officinale*; fruit of *Carica papaya*), (iii) Diarrhoea, heartburn, flatulence, itching, rash; large doses suppressed prolactin in men (berry of *Vitex agnus-castus*), nausea and vomiting (leaf of *Euphorbia loncifolia*), etc. Mradu and Badri (2011) performed an evaluation of the galactogogue action of the roots of *Asparagus racemosus* Willd.

during a randomized double blind clinical trial on lactating mothers having symptoms of deficient lactation by direct measurement of the prolactin hormone level and assessment of the secondary outcome measures. Findings showed that the roots of the plant exhibits significant galactogogue activity in comparison with the control group without any significant acute toxicity effect. A randomized controlled clinical trial aimed to determine the effect of *P. anisum* herbal tea on human milk volume and preterm infant weight in human populations was conducted by Khalili *et al.* (2023). The study population included breast feeders and premature infants who were hospitalized in the neonatal intensive care unit of Akbarabadi Hospital in Tehran, Iran. Findings showed a statistically significant difference in terms of milk volume in the first, third, fourth, fifth, sixth and seventh days between the three groups of intervention, placebo, and control. No statistically significant difference in terms of preterm infant weight on days 0, 3 and 7 between the three groups was observed. Another randomized clinical trial with intervention (n=47 participants), placebo (n=46 participants), and control groups (n=47 participants) was conducted by Izaddoost *et al.* (2023) to determine the effect of orally consumed *Lactuca sativa* syrup on human milk volume and subsequent weight gain in the preterm infant. Findings showed that *L. sativa* syrup enhances milk production.

CONCLUSION

The present study reviewed the existing data on medicinal plants used to promote lactation in breastfeeding Nigerien mothers. Published reports from the most important ethnobotanical surveys that were conducted across the country have served as support to retrieve the indicated plant species as galactagogues. While for all of these plant species, there were no preclinical or clinical studies performed locally to support the ethnopharmacological indication, evidence for only two plant species (*A. nilotica* and *G. senegalensis*) comes from international studies. For all the plant species listed in this study, local studies are urgently needed to support the ethnopharmacological indication and to evaluate their safety as an important component for consumer (breastfeeding mothers) health.

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