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Research Article

Galactagogue Effect of Oil Palm Sap from *Elaeis guineensis* Tree on Milk Production in Female Wistar Rats

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Abstract

As an old aged traditional practice, nursing mothers from south eastern Nigeria resort to using oil palm sap to induce and sustain lactation few hours after parturition. This practice is still ongoing despite the scarcity of clinical/scientific data supporting this plant product's efficacy and safety. This research was aimed to investigate the lactogenic effect of the juicy oil palm sap from African (*E. guineensis*) palm tree using lactating albino Wistar rats. After parturition, 66 primiparous female Wistar rats were randomly allocated into 11 groups of 6 dams each. Dams in group A and B were administered with normal saline and metoclopramide (5 mg/kg) respectively. Dams in group C and D with unfermented oil palm sap, G and H with fermented oil palm sap, groups E, F, I and J, were treated with combination of oil palm sap and bromocriptine (2.5 mg) while those in group K received bromocriptine (2.5 mg). Pup weight gain was used to quantify milk yield. Serum was harvested from the dams and assayed for prolactin (PRL) and oxytocin. The unfermented and fermented oil palm sap groups had significantly higher ($p < 0.05$) milk yield than the metoclopramide and normal saline treated groups. Serum concentration of prolactin and oxytocin were also significantly higher ($p < 0.05$) in the oil palm sap group including the combination group ($p < 0.05$). In conclusion, oil palm sap especially the fermented type exhibited galactopoietic potentials individually by increasing serum prolactin and oxytocin activities.

Keywords: Oil Palm Sap; Metoclopramide; Galactagogue; Igbo; Milk

Introduction

Breastfeeding is a natural recourse to maintaining mammalian species integrity and perhaps the oldest practice in human history [1]. The health benefits of this practice to mothers, infants, and society cannot be over-emphasized [2]. The World Health Organization (WHO) recommended that breastfeeding be initiated early and preferably within the first hour of birth. This practice, termed early initiation of breastfeeding (EIBF), gives the best possible start in the life of a new-born baby and its benefits for both mother and baby are well-documented [3,6]. Despite neonatal, infant and maternal benefits of early breastfeeding initiation, the compliance rates are low and mostly caused by insufficient milk production [1]. In developing countries and especially in rural areas where breast milk is the main infant food, hypogalactia (lactation failure) remains the major constraint related to breastfeeding.

To stimulate breast milk production immediately after parturition, most women use galactagogues to aid lactation, thereby increasing human breast milk production [7]. Several conventional galactagogues such as metoclopramide, sulpiride, domperidone, and chlorpromazine have been used to manage lactation failure [8]. These drugs are dopamine antagonists which inhibits breast

milk production. Despite their galactagogue activities, they are associated with unwanted side effects such as sedation, depression, weight gain, gastrointestinal disturbances, headache, nausea, and dry mouth [8]. For these side effects, an alternative approach to solving the problem of lactation failure was sort for.

Numerous herbs have been used in folklore medicine and scientifically proven to aid lactation in breastfeeding mothers. Examples include fenugreek (*Trigonella foenum-gracum*), blessed thistle (*Cnicus benedictus*), milk thistle (*Silybum marianum*), goat's rue (*Galega officinalis*) and fennel (*Foeniculum vulgare*), *Moringa oleifera* and Hibiscus sabdariffa [9,10]. Herbal galactagogues have gained popularity in the Western World [33]. Studies conducted in the United States, Australia, Norway, Switzerland, and Canada reported an estimated rate of 15% to 100% of breastfeeding mothers that have adopted herbal galactagogues [8,11]. In addition, this maternal choice of approach to lactation failure is determined mostly by their culture, traditional beliefs and, experiences [7,12].

As an old -aged traditional practice, nursing mothers from the South Eastern part of Nigeria resort to using oil palm sap to induce and sustain lactation immediately after parturition. This practice is still ongoing [1] despite the paucity of preclinical and clinical scientific validations supporting the oil palm sap efficacy, safety, and possible mechanism of action. Palm sap is the unfermented pale-yellow exudate from tapped unopened spathe of *E. guineensis* tree. On the contrary, the fermented palm sap also referred to as palm wine or palm toddy [13] is a refreshing alcoholic beverage consumed in some parts of Africa, Asia, and South America [14].

Considering the extensive indulgence in the practice of oil palm sap as local galactagogue amongst nursing mothers from the Igbo ethnic group of the South Eastern Nigeria. There is need to scientifically validated this traditional claim that its postpartum use stimulates milk production in lactating mothers. Hence, our study was designed to investigate the possible milk production effect of this plant exudate by measuring the weight and weight gain of each individual pup as well as evaluation of its effect on lactogenic hormones using laboratory animals. This innovative study offers great insight and provides information on the galactagogue potential of oil palm sap from *E. guineensis* tree on lactation.

Materials and Methods

Fresh palm sap from African oil palm (*E. gunieensis*) trees was collected daily from a palm wine tapper in Abor, Udi, local government area of Enugu State. Abor is a town in southeastern Nigeria, located in Enugu State near the city of Enugu, Latitude: 6° 28' 17.99" N Longitude: 7° 24' 17.99" E of the Greenwich meridian.

Experimental animals

The experimental protocol for this study was approved by the Research Ethics Committee of the Enugu State University of Science and Technology, College of Medicine, Enugu (Ethics Registration No: ESUCOM/FBMS/ETR/2020/004). A total of Sixty-six (66) primiparous females weighing 180-250g, aged 7 to 8 weeks, were randomly selected and mated in batches for this study, they were housed in cages, fed with standard grower's mash rat pellets (Farmer's Friend Agro Enterprise, Enugu) and had free access to water. Following parturition, the number of pups per dam was culled to 6 pups per litter [15,16] and weight of pups was recorded daily from postnatal day 2 (PND 2) till PND 12.

Lactation study

The pregnant rats were allowed to deliver their young and the day of parturition was designated as Day 1 of lactation. All the lactating rats were randomly divided into eleven (11) groups of six (6) rats each (n = 6). Each mother was adjusted to have only six pups per litter within 24 hrs. Group A, the normal control group received distilled water. Group B, which received 5mg/kg of metoclopramide was used as positive control while group K which received 2.5mg/kg of bromocriptine was used as the negative control. Groups C, D, G and H received 10 ml/kg and 20 ml/kg of fermented and unfermented oil palm sap respectively, while groups E, F, I and J received 10 ml/kg and 20 of fermented and unfermented oil palm sap respectively with 2.5mg/kg of bromocriptine. Treatment was done for a period of eleven (11) days.

Measurement of milk yield

A measure of milk yield was deduced by measuring the weight and weight gain of each pup using the weight-suckle-weight (WSW) method [10] with an electronic weighing scale (digital high precision scale, model no: JY503B, made in China. 500/0.001g). It was estimated 18 hours and 23 hours after gavage indirectly from the relationship between weight gain of pups pre and post

suckling of the dams as described in other studies [17]. Following administration of the experimental agents upon delivery, the pups were weighed every day during the study period at 07:00 am and recorded as (W1). They were immediately isolated from their dams for four (4) hours. At 11:00 am, the pups were weighed again (W2), then reunited with their dams to feed for 1 hour, after which they were weighed again at midnight (W3) and separated from their dams a second time for four (4) hours (between 12:00 pm and 4:00 pm), then weighed (W4) and re-united with their dams to feed for an hour. At 17:00 pm, they were weighed and considered (W5) and left with their dams throughout the night. This was done daily until PND 12. Milk yield 18 hours after gavage was estimated as W3 - W2 with a correction for weight loss due to metabolic processes in the pups as (W2 - W1)/4 while milk yields 23 h after gavage was estimated as w5 - w4 with a correction for weight loss due to metabolic processes in the pups as [(w2 - w1) + (w4 - w3)]/8 [10,18].

Blood sample collection and serum preparation

On the 15th day of parturition, the blood samples were collected from lactating rats through retro-orbital plexus to evaluate hormones relevant to breastfeeding following administration of drugs and plant substrate. The blood samples were centrifuged at 2000 revolutions per minute for 10 minutes using Centrifuge Hettich (Universal 32, Made in Germany) and allowed to separate. Subsequently, serum was collected with a Pasteur pipette and dispensed into a clean Eppendorf tube for the measurements of the prolactin and oxytocin level [19].

Results

Milk production: There was increased milk yield 18 hours after gavage in all the treated groups, the milk yield increased significantly ($p < 0.05$) in groups A to K each new day compared to the previous day but decreased significantly ($p < 0.05$) each new day from PND 4 compared to the previous day in group K. Milk yield of dams in groups that received metoclopramide and oil palm sap were markedly increased when compared to that of the normal and negative control groups respectively as illustrated in figure 1a. After an 18hour gavage by PND 12, the milk yield was 1.71 ± 0.06 and 1.82 ± 0.12 for the dams treated with normal saline and metoclopramide, respectively. The groups that were treated with unfermented palm sap recorded milk yields of 1.80 ± 0.09 and 2.0 ± 0.04 for the low and high doses respectively. In contrast, the milk yield of 1.95 ± 0.08 and 2.01 ± 0.05 was obtained from the groups that received a low and high dose of the fermented palm sap, respectively (Figure 1a).

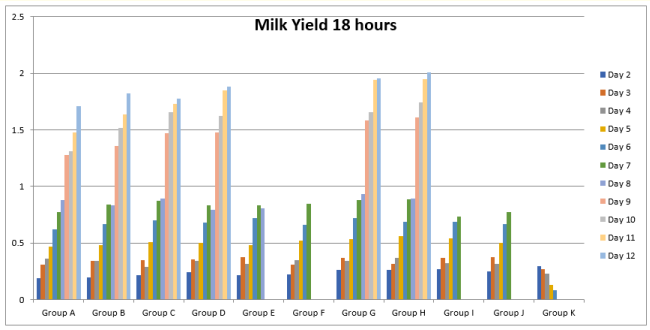

Figure 1a: Total milk yield of dams after 18-hour gavage.

After 23-hour gavage, by the 11th day of admiration of plant substrate and conventional galactagogue, the milk yield of 2.02 ± 0.04 and 1.98 ± 0.08 was obtained from the groups that received a high and low dose of the fermented palm sap, respectively, while the group that was treated with unfermented palm sap milk yield of 1.81 ± 0.06 and 1.90 ± 0.07 for the low and high dose respectively. The group treated with normal saline and metoclopramide had milk yield of 1.75 ± 0.09 and 1.81 ± 0.09 by the PND 12 (Figure 1b).

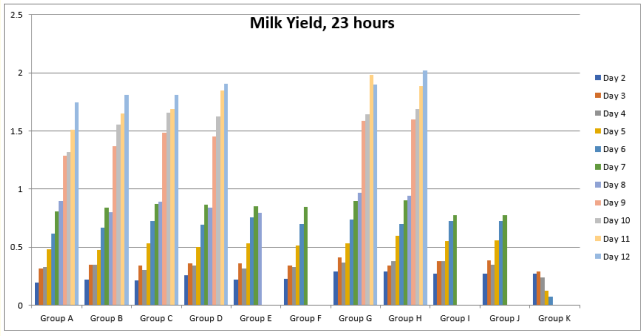

Figure 1b: Total milk yield of dams after 23 hours gavage.

Body weight: All pups gained weight during the study period, and the rate of weight gain for the treated groups was significantly higher than that of the controls. The weight gain of pups by PND 12 was significantly ($p < 0.05$) higher in groups whose dams were treated with fermented and unfermented oil palm sap when

compared with normal saline and metoclopramide treated groups. Pups from the dams in the group treated with a combination of oil palm sap and bromocriptine (combination-treated group) also showed progressive weight gain but not as appreciable as the pups from normal saline and metoclopramide groups. However, pups in the bromocriptine treated group had the lowest weight gain (Figure 2).

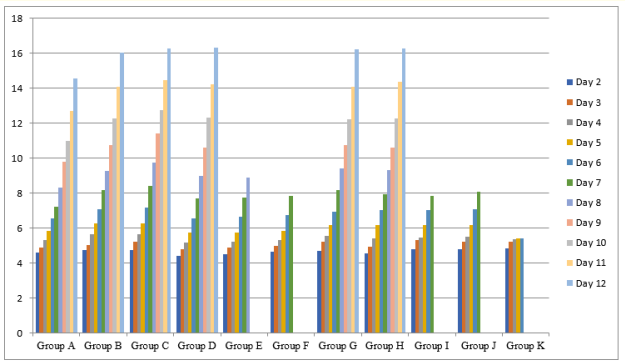

Figure 2: Daily weight gain of pups in the experimented lactating Wister rats.

Effect of oil palm sap on the serum level of hormones relevant to lactation (prolactin and oxytocin). The mean prolactin level was significantly increased ($p < 0.05$) in the group treated with metoclopramide, unfermented and fermented oil palm sap (21.3, 12.4, and 11.4 ng/ml respectively). However, the prolactin level was significantly ($p < 0.05$) reduced in the dam that received bromocriptine when compared with that of other groups (Figure 3a).

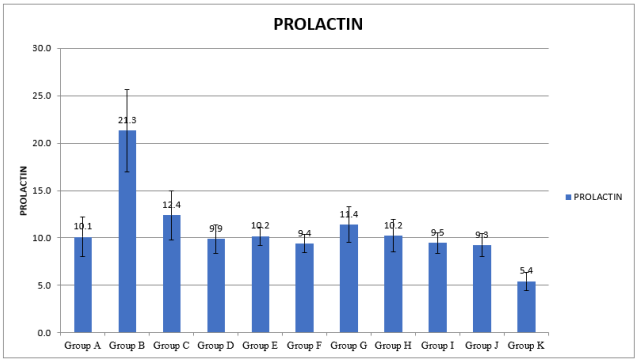

Figure 3a: Effect of administration of *E. gunieensis* sap on Serum Prolactin level in female lactating Wistar rats.

The results obtained in this experiment also showed that serum oxytocin level was increased in the unfermented and fermented oil palm treated groups when compared with other groups (Figure 3b).

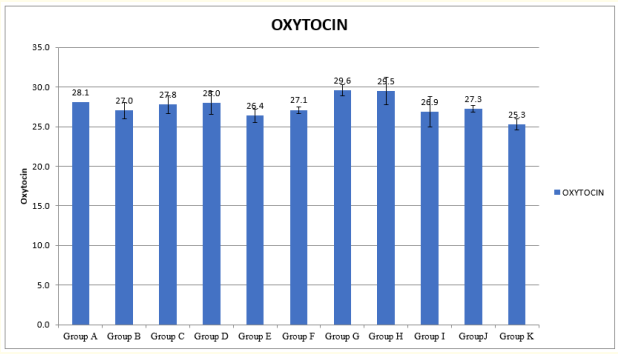

Figure 3b: Effects of *E gunieensis* sap on serum oxytocin concentration in female lactating Wistar rats.

Discussion and Conclusion

Breastfeeding is influenced by certain factors such as endocrinologic imbalance, health and climate which cumulatively affect milk synthesis and secretion. These factors also influence milk production leading to agalactias and hypogalactia (lactation failure) which remains the major constraint related to breastfeeding1. Metoclopramide is a synthetic galactagogues, acting by blocking the dopamine receptor and increasing the production of prolactin. Therefore, has been used as reference galactagogue in various preclinical studies [8].

The purpose of this study was essentially to validate the traditional use of oil palm sap as a galactagogue. Milk production was significantly ($p < 0.05$) higher in lactating rats treated with fermented and unfermented oil palm sap (at dose levels of 10 ml/kg and 20 ml/kg respectively) than in the reference drug metoclopramide (5 mg/kg) treated group which served as the positive control group. Oil palm sap produced an appreciable increase in serum levels of hormones relevant to lactation (prolactin and oxytocin). Thus, the increased milk yield recorded in our study could have been due to the effect of oil palm sap on the levels of the serum lactogenic hormones studied.

The increase in milk yield in the oil palm sap treated group, including the combination group, was attributed to a synergistic

effect of the vitamins and mineral compounds that have been reportedly isolated from oil palm sap, especially the fermented type [23]. Several studies have reported the presence of trace elements and vitamins in oil palm sap, [20-22] that are linked to the possible mechanism of action of the plant product on lactating mothers [23]. Erukainure., *et al.* also documented the antioxidant activity of the oil palm sap in a preclinical study [24]. The increase in milk yield in the oil palm sap treated group could also be attributed to the presence of alkaloids, sugar, saponins, tannins, saponins, and flavonoids which has been reported to be in present in abundance in oil palm sap from *E. guineensis* tree [35,36].

Many studies have also identified probiotics such as saccharomyces cerevisiae yeast (SCY) present in numerous plant extracts as galactagogue in breastfeeding women and animals [16-25]. Saccharomyces species have been isolated from palm wine, [27,28] and it constitutes about 70% of the total yeast of palm wine [29]. Saccharomyces cerevisiae yeast products are also widely used as dietary supplements to increase milk yield in ruminants [30-32]. The increased milk yield in the oil palm sap treated group could also be attributed to saccharomyces cerevisiae yeast (a unicellular fungus commonly isolated from sugary foods).

The mechanism through which this plant substrate exerted its effect is unknown, it can be deduced from our study that oil palm sap, the milky white sugary beverage obtained from the *E guineensis* tree, increased milk yield as well as lactogenic hormones in the studied lactating rats, probably due to its rich content of bioactive substances, microorganisms and rich mineral elements which may suggest its lactogenic role.

In conclusion, oil palm sap possesses positive lactogenic activity in lactating female rats. It can be stated that oil palm sap used in the present study effectively increased milk production as well as synthesis and release of lactogenic hormones in lactating albino Wistar rats. These properties could be attributed to the substances contained in this plant substrate. Our result could militate favour of the long-aged socio-cultural practice among mothers in South-eastern Nigeria, where oil palm sap is used to induce and sustain lactation after parturition. However, standardized scientific clinical trials and toxicogenomic screening of this plant product are advised.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original, has not been published in whole elsewhere and did not receive any external funding.

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