Egyptian Journal of Nutrition Official journal of the Egyptian Nutrition Society Print ISSN: 1687-1235 Online ISSN: 2090-2514 Vol. 40 (2): 36 – 49 (2025) DOI:10.21608/enj.2025.432388 https://ejn.journals.ekb.eg/



Nutritional Assessment of Traditional Complementary Food (*Tom-brown*) and Maternal Practices for Feeding in Southwestern Nigeria

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ABSTRACT

Malnutrition in Nigeria poses severe health risks to children, necessitating urgent evaluation of traditional complementary foods and enhancing nursing mothers' awareness to improve nutritional practices and combat this public health crisis. This study employed a mixed-method approach, conducting nutritional analyses of traditional complementary foods and surveys with 370 nursing mothers across Osun State, utilizing structured questionnaires and statistical software for data analysis to assess knowledge and practices. The analysis revealed significant variations in the nutritional content of commercially sold tom-brown foods, with moisture levels highest in Ede samples (8.62%) and protein highest in Babcock samples (11.41%). The presence of Aspergillus niger in Ede samples raised food safety concerns, emphasizing the need for improved processing methods. While knowledge levels were generally high, only 49.2% of mothers recognized the benefits of extended breastfeeding. Although 88.4% believed infants thrive on breast milk alone for six months, misconceptions about introducing water or honey were prevalent, with 46.2% opposing these practices. Although 88.4% believed infants should be fed on breast milk alone for six months, only 49.2% recognized the benefits of extended breastfeeding. Notably, 55.4% of mothers preferred traditional foods, especially tom-brown, over commercial options. The findings emphasize the critical need for culturally relevant nutritional interventions aimed at enhancing maternal understanding of complementary feeding practices, thereby contributing to improved nutritional outcomes and reduced malnutrition rates among infants.

Keywords: Traditional food safety, Nutritional awareness, Cultural practices, Complementary feeding

Received: 28-5-2025

Accepted: 9-6-2025

PublishedIssue2-2025

INTRODUCTION

Malnutrition is a pressing public health crisis, particularly in low- and middle-income countries, where it significantly contributes to child morbidity and mortality. The World Health Organization (WHO) estimates that malnutrition is responsible for approximately 45% of deaths among children under five, primarily due to undernutrition (Vassilakou, 2021). In Nigeria, the situation is alarming, with about 44% of children experiencing stunting, 32% underweight, and 11% wasted (Olabimpe and Adeola, 2023). These statistics underscore the urgent need for effective nutritional interventions during the critical complementary feeding period.

Exclusive breastfeeding is crucial for infants' nutrition during the first six months; however, complementary feeding becomes vital afterward to support rapid growth and development. This phase significantly shapes lifelong dietary habits (Dzudzor et al., 2024). In Nigeria, cultural practices often lead to the introduction of various complementary foods, with traditional options playing a key role. However, many of these foods lack essential micronutrients like iron and zinc (Ajayeoba et al., 2022).

Ogi, a fermented cereal gruel made from maize, sorghum, or millet, serves as a common complementary food (Adebiyi et al., 2021). *Tom-brown*, commonly known as *Turn-brown*, is a traditional Nigerian complementary food made from a blend of locally sourced cereals and legumes, such as soya beans, millet, corn, and groundnuts, which are roasted and ground into a nutritious powder often prepared as porridge for infants and young children to support their growth and prevent malnutrition (Ajayeoba et al., 2022). Despite their accessibility compared to commercial alternatives, the nutritional quality of these traditional foods can vary significantly based on local processing methods. This study aims to evaluate the proximate composition, micronutrient content, and anti-nutritional factors in traditional complementary foods sold in major markets across Osun State. Additionally, it will explore nursing mothers' knowledge gaps regarding complementary feeding practices.

MATERIALS AND METHODS

Location of study

The study area for the purchase of the commercially sold *tom-brown* are selected towns: Ibadan (Bodija market), Ede (Timi market), Osogbo (Igbona market) and Ilishan-Remo (Babcock Supermarket) in Southwestern Nigeria. The study area for assessing nursing mothers was carried out at major Primary Health Care Centres located at Ede, Oshogbo, Ife, Ikirun, Iragbiji and Ejigbo towns in Osun State (Table 1). The services offered include Antenatal Clinic, Newborn Delivery, Children and Adult Vaccination, Diseases Surveillance, Family Planning and General Outpatient services.

Sources of Materials

The media (Potato Dextrose Agar, Yeast extract sucrose) used for this research work were purchased from Oxoid and the chemicals used were Sigma products.

Table 1: Location	of Primary	Heath	Care (Centers	with	their	Local	Governm	ent Areas
for the Study									

Location	Name of Primary Health Care Centres PHC	Local Government Area
Ede	Oja Timi PHC, Ede. Oke Gada PHC	Ede North LGA
Oshogbo	Dada Estate PHC, Oshogbo.	

Ife	Sabo Health Centre	Ife Central LGA
Ikirun	Moboreje, Central PHC, Ikirun.	Ifelodun LGA
Iragbiji	Central PHC, Iragbiji.	Boripe LGA
Ejigbo	Popo PHC, Ejigbo.	Ejigbo LGA

The target population for this study were nursing mothers attending infant health clinics at major Primary Health Care Centers in selected towns of Osun State.

Inclusion and exclusion criteria

Nursing mothers with infants less than 24 months old attending primary health care centers in selected towns of Osun State who willingly gave their consents were included in this study while nursing mothers with infants older than 24 months was excluded from the study and those who were reluctant to give their consents.

The Sample size will be calculated using the Fisher's formula: $n = \frac{z^2(p(1-p))}{d^2}$

Where: n -Sample size

z- Standard normal deviate corresponding to confidence level at 95% confidence interval (1.96)

P- Prevalence of malnutrition (undernutrition) of under five children in Nigeria =32% (Omotesho et al., 2019)

d- degree of accuracy required (5% = 0.05)

$$n = \frac{1.96^2 \times 0.32 (1 - 0.32)}{0.05^2}$$

$$n = \frac{0.83593216}{0.0025}$$

n= 334 = 367 (10% nonresponse rate) approximately 370
n=370

Proportionate random sampling method was employed in enrolling respondents. The respondents were enrolled by calculating the relative sample size in each town using the population of under five children living at each selected town in Osun State. The 370 respondents were selected randomly at the major infant health centers at Ede, Oshogbo, Ife, Ikirun, Iragbiji and Ejigbo towns in Osun State.

Methods

This research work was carried out in two stages. The first stage involves the proximate analysis (moisture content, protein content, crude fiber, total ash, crude fat, and antinutritional components (total saponin, tannin, tannic acid, trypsin inhibitor) of the commercially sold *tom-brown*, which was evaluated as follows according to the (AOAC, 2010) method while the isolation and identification of aflatoxigenic fungi according to the method described by (Ajayeoba et al., 2019). For the second stage, behavioural assessment of nursing mothers towards traditional complementary food (*tom-brown*) were carried out.

The study employed a structured questionnaire adapted from (Shrestha et al., 2020), which was translated into Yoruba to enhance understanding among participants. Following translation, the questionnaire was retranslated into English to ensure consistency. Data collection involved individual interviews conducted by trained data collectors using this pretested instrument, organized into four sections: socio-demographic details (Section A), knowledge of complementary feeding (Section B), attitudes of nursing mothers towards complementary feeding (Section C), and actual complementary feeding practices (Section D). Ethical approval was granted by the Ethics and Research Committee of Adeleke University, Ede (AUERC/2023/33PH/14).

To ensure the validity and reliability of the questionnaire, experts in public health reviewed its construct. A pre-test involving 37 nursing mothers (10% of the sample size) at

Oja Timi Primary Health Care Centre established reliability, yielding Cronbach's alpha coefficients of 0.85 for knowledge, 0.72 for attitude, and 0.75 for practice. Data from nutritional evaluations of commercially sold *tom-brown* were analyzed using SPSS 22.0, with analysis of variance applied and Tukey's test used to identify significant differences ($p \le 0.05$). The relationship between knowledge, attitudes, and practices regarding complementary feeding in selected towns of Osun State was statistically compared using SAS 92.2 with Pearson chi-square analysis, considering incidences statistically significant at $p \le 0.05$.

RESULTS AND DISCUSSION

Nutritional analysis

The nutritional analysis of commercially sold tom-brown in selected locations within Southwest Nigeria reveals critical insights into its dietary value and safety. The analysis, as shown in Table 2, indicates no significant differences ($p \le 0.05$) in crude protein, crude fiber, and crude ash among the samples. However, significant variations were observed in moisture, crude fat, and carbohydrate content. Notably, the Ede sample exhibited the highest moisture level at 8.62%, raising concerns about its susceptibility to microbial degradation and reduced shelf life compared to the Babcock sample, which had the lowest moisture content at 5.55%. Conversely, the Babcock sample recorded the highest crude protein at 11.41%, while the Ibadan sample had the highest carbohydrate content at 65.82%. The anti-nutritional analysis highlighted a significant difference in tannin levels, with the Ibadan sample showing a remarkably high concentration of 99.94%. These findings underscore the importance of explicit nutritional labelling to guide consumer choices aligned with individual dietary needs and preferences, promoting healthier eating behaviours (Kiesel et al., 2011, Shangguan et al., 2019). The discrepancies in moisture and fat content not only reflect product quality but also have implications for consumer health and storage practices (Geay et al., 2001, Mauer, 2024). Furthermore, the elevated tannin concentration in the Ibadan sample poses potential health risks by hindering protein digestion and mineral absorption (Sharma et al., 2021). Thus, consistent monitoring and effective processing methods are essential to mitigate the adverse effects of anti-nutritional components in tom-brown products.

The analysis revealed *Aspergillus niger* in the Ede sample, raising food safety concerns despite it being non-aflatoxigenic. This contamination poses serious health risks to infants, including potential mycotoxin production leading to immunosuppression and gastrointestinal issues. Stricter post-harvest handling and storage practices are essential to mitigate such risks (Ráduly et al., 2020).

Proximate	analysis	Location of sampl	ing		
Parameters		Babcock	Ede	Ibadan	Osogbo
Moisture %		5.55±0.11 ^a	8.62 ± 0.03^{b}	6.04 ± 0.11^{a}	5.71 ± 0.04^{a}
Crude Protein %		15.20 ± 0.05^{a}	14.38 ± 0.05^{a}	14.79 ± 0.04^{a}	15.10±0.03 ^a
Crude Fat %		11.41 ± 0.05^{a}	10.13 ± 0.12^{a}	8.81±0.03 ^b	10.11±0.04 ^a
Crude Fiber %		2.19 ± 0.04^{a}	2.15 ± 0.05^{a}	2.07 ± 0.03^{a}	2.14 ± 0.03^{a}
Total Ash %		2.62 ± 0.06^{a}	2.49 ± 0.03^{a}	2.49 ± 0.04^{a}	2.57 ± 0.01^{a}
NFE %		$63.05 \pm 0.09^{a,b}$	62.25 ± 0.12^{b}	65.82 ± 0.11^{a}	64.38 ± 0.08^{a}
Anti-nutritional o	content				
Tannin (100mg/ml)	87.56 ± 0.26^{a}	89.19 ± 0.04^{a}	99.94 ± 0.19^{b}	89.15 ± 0.45^{a}
Trypsin	Inhibitor	15.25 ± 0.37^{a}	$15.10{\pm}0.18^{a}$	14.94 ± 0.01^{a}	14.93±0.09 ^a
(100mg/ml)					
Saponin (%)		2.69 ± 0.04^a	2.46 ± 0.08^{a}	2.08 ± 0.12^{a}	2.41 ± 0.06^{a}
Results represented	as means \pm	Standard deviation.	Means with same s	uperscript letters in t	the same column are

Table 2: Proximate and anti-nutritional contents of the *tom-brown* sampled from selected market within southwest Nigeria

Results represented as means \pm Standard deviation. Means with same superscript letters in the same column are not significantly different (p \leq 0.05).

Table 3: Morphological description of presumptive fungal species

Location	Presumptive fungal species	Morphological/Microscopic features on PDA	Potentials of aflatoxin production
Babcock	-	-	
Ibadan	-	-	
Osogbo		-	
Ede	Aspergillus niger	They are Blackish-brown often with yellow mycelium. Reverse greenish-yellow to yellow orange. They have a glubose head, splitting with age and their mutale is long closely packed and brownish.	Negative

Attitude, knowledge and practice of nursing mothers towards the administration of complementary foods

The knowledge attitude and practices of nursing mothers towards complementary feeding is shown in Tables 4-7. Table 4 outlines the socio-demographic characteristics of 370 nursing mothers in the study. Most respondents are from Oshogbo (20.8%) and aged between 20 and 35 (79.5%). A significant majority (91.9%) are married, indicating potential spousal support in feeding practices. The sample is predominantly Yoruba (93.6%), with 60.8% Christians and 39.2% Muslims. Educationally, 64.1% have tertiary education, while 77.3% are self-employed. Notably, 59.7% have 5-6 children, enhancing their child-rearing experience, and over half (58.6%) of the children are aged 7-12 months, a crucial period for introducing complementary foods. The socio-demographic characteristics of the nursing mothers indicate a well-educated and predominantly married population, which may enhance support for optimal feeding practices. The significant number of mothers aged 20-35 suggests that health education programs should be tailored to this demographic, focusing on complementary feeding during the critical period of 7-12 months. The findings emphasizes the need for tailored health education initiatives on complementary feeding that make use of the educational background and social support of these mothers to improve nutritional outcomes and reduce malnutrition risks (Fadare et al., 2019). Given their experience and the developmental stage of their infants, targeted interventions can enhance adherence to supplemental feeding guidelines, ultimately promoting optimal growth during this vital period (Du et al., 2024)

Statements	Characteristic	frequency (n)	percentage (%)
Location	Iragbiji	38	10.3
	Ejigbo	54	14.6
	Ikirun	56	15.1
	Oshogbo	77	20.8
	Ede	74	20.0
	Ife	71	19.2
Mother's Age			
	Less than 20	6	1.6
	20 - 35	294	79.5
	Greater than 35	70	18.9
Marital Status			
	Single	30	8.1
	Married	340	91.9
Religion			
-	Christian	225	60.8
	Muslim	145	39.2
Ethnicity			
2	Yoruba	346	93.6
	Ibo	24	6.4
Educational Level			
	Secondary Education	133	35.9
	Tertiary Education	237	64.1
Employment Status	-		
	Employed	78	21.1
	Self Employed	286	77.3

Table 4	: Resp	ondent's s	ocio-dem	ographic	characteristics	(n=370)
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	Unemployed	6	1.6	
Number of Children				
	0-2 children	40	10.8	
	3-4 children		18.4	
		68		
	5-6 children	221	59.7	
	7 and above			
		41	11.1	
Age of Children				
-	0-6 months	93	25.1	
	7-12 months	217	58.6	
	13-18 months	60	16.2	
Sex of Child				
	Male	259	70.0	
	Female	111	30.0	

Table 5 assesses mothers' knowledge of breastfeeding and complementary feeding, revealing that 84.6% know to initiate breastfeeding within one hour of birth, and 100% understand the need for on-demand feeding. While 86.8% correctly identify the appropriate age for introducing complementary foods as 5-7 months, only 49.2% recognize the benefits of breastfeeding beyond two years. About 59.5% believe employment does not affect breastfeeding duration, indicating a potential gap in understanding workplace policies. Medical staff are seen as primary influencers (88.1%), emphasizing their role in promoting best practices. Additionally, 55.4% prefer traditional foods over commercial options, and while 52.2% continue breastfeeding up to 13-18 months, only 6.2% breastfeed beyond 25 months, reflecting early weaning practices. The findings reveal critical gaps in mothers' knowledge of breastfeeding and complementary feeding, particularly regarding the benefits of extended breastfeeding and the impact of employment on duration (Makwela et al., 2024), highlighting the need for targeted educational interventions by healthcare professionals to promote best practices and improve child health outcomes

Statements	Responses	Frequency	%
At what time should the infant be introduced to breastfeeding?	Within one hour after birth	313	84.6
	After one hour following birth	11	3.0
	I don't know	46	12.4
How often should you breastfeed your baby?	ON Demand	370	100
Are there conditions that could warrant no breastfeeding of infant?	Yes	181	48.9
oreastreeding of infant?	No	189	51.1
How long should you breastfeed before giving other foods	5-7 months	321	86.8
String only roods	8 months and above Not sure	38 11	10.3 3.0

Fable 5: Mothers	' knowledge	regarding	complementary	feeding
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Breastfeeding should be continued up to 2 vears and beyond	Yes	182	49.2
	No	188	50.8
Does the working status of the mother affects the period of breastfeeding?	Yes	150	40.5
	No	220	59.5
Which source of information influenced	Family Members		
the choice of your complementary feeding?		14	3.8
	Medical staff	326	88.1
be introduced after desire period of exclusive breastfeeding?	food	205	55.41
	Commercial complementary food	165	44.59
After introducing complementary foods	7 - 12 months		
how long should you continue breast feeding?		23	6.2
i i i i i i i i i i i i i i i i i i i	13-18 months	193	52.2
	19- 24 months	114	30.8
	25 months and above	6	1.6
How often should a child on complementary food be fed a day?	On demand	227	61.4
1 ,	Twice	47	12.7
	Thrice	96	25.9

Table 6 reveals nursing mothers' attitudes and beliefs regarding breastfeeding and complementary feeding. An impressive 88.4% strongly agree that infants can thrive on breast milk alone for the first six months, aligning with WHO guidelines. However, attitudes toward traditional practices are mixed, with 46.2% disagreeing and 37% strongly disagreeing about introducing water or honey during this period. Notably, 67.8% oppose ceasing feeding during illness, reflecting a commitment to maintaining nutrition. Furthermore, 89.2% recognize the importance of complementary feeding for child development, while all respondents acknowledge maternal education's significance, underscoring the need for ongoing educational initiatives. Lastly, 87.6% support using feeding bottles when breastfeeding is refused, indicating flexibility in feeding approaches despite associated risks. Inadequate knowledge and misconceptions about breastfeeding and complementary feeding among nursing mothers can lead to suboptimal feeding practices, guidelines (Ajmal, 2024), increasing the risk of malnutrition and associated health issues in infants, thereby

underscoring the necessity for targeted educational interventions by healthcare professionals to enhance maternal understanding and adherence to recommended (Lopez et al., 2018)

Statements	Responses	Frequency	%
It is possible for a baby to survive	Strongly Agree		
only on breast milk for the first six months of life		327	88.4
	Agree	43	11.6
It is important to give the baby some	Strongly Agree		
water, honey during the first six months		18	4.9
	Agree	44	11.9
	Disagree	171	46.2
	Strongly Disagree	137	37.0
Feeding should be stopped during	Agree	11	3.0
illness		11	5.0
	Disagree	251	67.8
	Strongly Disagree	108	29.2
Complementary food is vital for child	Strongly Agree	134	36.2
development			
	Agree	196	53.0
	Disagree	40	10.8
Exclusive breastfeeding is enough for the child before six months	Strongly Agree	310	83.8
	Agree	60	16.2
initiation of complementary feeding is vital	Strongly Agree	150	40.5
	Agree	220	59.5
Do you prefer traditionally prepared	Strongly Agree	222	07.0
complementary foods?	6, 6	322	87.0
	Agree	48	13.0
Feeding bottles are best options for	Strongly Agree		
feeding children who have refused to breastfeed		149	40.3
	Agree	175	47.3
	Disagree	46	12.4

Table 6: Mother's attitude towards complementary feeding

The findings indicate that nursing mothers possess a generally positive attitude towards breastfeeding and complementary feeding, with 88.4% affirming that infants can survive solely on breast milk for the first six months, in line with WHO recommendations. However, there are mixed views on introducing water or honey during this period, with significant disagreement among mothers. Most (67.8%) reject the notion of stopping feeding during illness, and 89.2% recognize the importance of complementary feeding for child development. Additionally, all respondents value maternal education, highlighting the need for ongoing educational efforts. The

mixed attitudes towards introducing water or honey during the first six months suggest a potential risk of misinformation that could undermine

exclusive breastfeeding practices (Gupta et al., 2019), emphasizing the critical need for targeted educational interventions to enhance mothers' understanding of optimal feeding practices and improve infant health outcomes.

Statements	Responses	Frequency	%
All respondents washed their hands with soap and water before feeding the infant.	4-6 months	130	35.1
8	7-9 months	132	35.7
	10 months above	108	29.2
If introduced earlier than six months, what were the reasons for introducing complementary foods?	Baby was crying a lot at work	108	29.2
	Mother didn't have	172	46.5
	Illness	90	24.3
Are you still breastfeeding?	Yes	358	96.8
	No	12	3.2
How many times per day do you feed your child?	On demand	208	56.2
	Twice	132	35.7
	Thrice	30	8.1
What feeding utensils do you use to feed the child	Bottle	54	14.6
	Cup	105	28.4
	Spoon	211	57.0
What type of traditional complementary food do you use?	Maize-based Ogi	71	19.2
	Multi-grain Ogi (fermented)	145	39.2
	Multi-grain roasted blends (tom-brown)	154	41.6
Why do you use that type of traditional complementary feed?	Fermented ogi is sour	67	18.1
	<i>Tom-brown</i> is richer in nutrients	140	37.8
	I don't know	92	24.9
	That is what I used for my older children	71	19.2
Do you boil drinking water?	Always Sometimes	367 3	99.2 .8

Table 7: Mother's feeding practices on complementary feeding

Do you wash your hands with soap before feeding the baby	Yes	370	100
During illness does the child require less than usual to drink/eat, about the same amount, or more usual to drink?	Less	291	78.6
	Same	79	21.4
	Total	370	100.0

Table 8 presents a correlational analysis of nursing mothers' knowledge, attitudes, and practices regarding complementary feeding in Osun State. The analysis reveals a strong positive correlation (R = 0.713) between knowledge and attitudes, indicating that increased knowledge enhances favourable attitudes towards complementary feeding. Furthermore, a very strong correlation (R = 0.919) exists between knowledge and actual feeding practices, suggesting that improved knowledge significantly influences better complementary feeding practices. This highlights the importance of education in shaping mothers' perceptions and behaviours related to child nutrition. The strong positive correlation (R = 0.713) between maternal knowledge and attitudes towards complementary feeding suggests that improving education could foster more favorable attitudes. Additionally, the very strong correlation (R = 0.919) between knowledge and actual feeding practices highlights the need for targeted educational interventions. These findings, supported by significant p-values, indicate that enhancing maternal understanding of complementary feeding can improve child nutrition and health outcomes in Osun State (Apara et al., 2024, Arikpo et al., 2018, Marshall et al., 2022)

Table 8:	Correlation	Analysis	of Knowledg	e, Attitudes,	, and	Practices	in	Complementary
Feeding	Among Careg	ivers in Osu	ın State					

Variable	Knowledge on Complementary Feeding	Attitude Towards Complementary Feeding	Complementary Practices		
Knowledge on Complementary		0.712*	0.010**		
Feeding	Pearson Correlation	0./13*	0.919**		
	Sig. (2-tailed)	0.003	0.000		
	Ν	370	370		
Attitude Towards					
Complementary Feeding	Pearson Correlation	1	-		
	Sig. (2-tailed)	-	-		
	Ν	370	-		
Complementary Practices	Pearson Correlation	-	1		
	Sig. (2-tailed)	-	-		
	Ν	-	370		

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

CONCLUSION

This study highlights the critical necessity for thorough interventions to tackle malnutrition in Nigeria, especially focusing on traditional complementary foods and the practices of nursing mothers. The nutritional analysis of commercially sold *tom-brown* foods showed notable differences in moisture, protein, and anti-nutritional factors. The findings suggest a need for awareness among mothers about the best practices for introducing complementary foods. Although breastfeeding initiation rates are high, a significant number of mothers are unaware of the advantages of extended breastfeeding, highlighting essential knowledge deficiencies that need to be tackled.

The positive attitude demonstrated by nursing mothers regarding breastfeeding and complementary feeding practices indicate an appropriate foundation for the development of educational initiatives. It is essential to address misunderstandings regarding the introduction of water and honey in infancy to ensure that practices are consistent with health guidelines. The investigation highlights the importance of culturally relevant educational initiatives aimed at nursing mothers to improve their comprehension and compliance with suggested feeding practices.

Enhanced nutritional outcomes of infants via personalized interventions can also be achieved by harnessing the socio-demographic characteristics of a target population, especially with high educational levels and spouse support. This study supports a comprehensive strategy that integrates nutritional education with community involvement to effectively address malnutrition and encourage healthier feeding practices among nursing mothers in Nigeria.

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