

# CUIDADO É FUNDAMENTAL

Escola de Enfermagem Alfredo Pinto – UNIRIO

RESEARCH

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## ENERGY CONTENT OF HUMAN MILK ADMINISTERED TO PREMATURE NEWBORNS

*Conteúdo energético do leite humano administrado em recém nascidos prematuros**Contenido energético de la leche humana administrada a recién nacidos prematuros*Izabela Viegas Cunha<sup>1</sup> Mônica Pereira Lima Cunha<sup>2</sup> Amanda Silveira Mariano<sup>2</sup> Rejane Corrêa Marques<sup>3</sup> 

### ABSTRACT

**Objective:** to evaluate and compare the energy content of raw human milk and processed human milk from preterm newborns.**Method:** 68 milk samples were collected by hand milking and processing was carried out at the Human Milk Bank. The energy value was obtained through specific mathematical calculations. **Results:** 32 samples of raw human milk and 28 of pasteurized human milk were analyzed. The average percentage of cream was  $3.84 \pm 1.3\%$  and a median of 4.5% in pasteurized milk, and in raw milk,  $8.9 \pm 4.6\%$  and 8.53%. The mean and median energy content of raw milk was  $78.91 \pm 15.46$  kcal/100 ml and 81.07 kcal/100 ml and in pasteurized milk  $65.18 \pm 9.67$  kcal/100 ml and 61.8 kcal/100 ml. **Conclusion:** raw human milk has a higher percentage of fat and energy content than pasteurized milk, but it is still recommended due to its protective benefits.**DESCRIPTORS:** Milk, human; Nutritive value; Infant, premature.

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## RESUMO

**Objetivo:** avaliar e comparar o conteúdo energético do leite humano cru e do leite humano processado de recém-nascidos pré-termo. **Método:** foram coletadas 68 amostras de leite por meio de ordenha manual e o processamento foi realizado no Banco de Leite Humano. O valor energético foi obtido por meio de cálculos matemáticos específicos. **Resultados:** foram analisadas 32 amostras de leite humano cru e 28 de leite humano pasteurizado. O percentual médio de creme foi de  $3,84 \pm 1,3\%$  e mediana de  $4,5\%$  no leite pasteurizado, e no cru de  $8,9 \pm 4,6\%$  e  $8,53\%$ . A média e mediana do conteúdo energético do leite cru foi de  $78,91 \pm 15,46$  kcal/100 ml e  $81,07$  kcal/100 ml e no leite pasteurizado  $65,18 \pm 9,67$  kcal/100 ml e  $61,8$  kcal/100 ml. **Conclusão:** o leite humano cru possui percentual de gordura e conteúdo energético maior do que o pasteurizado, mas este ainda é recomendado devido seus benefícios protetores.

**DESCRITORES:** Leite humano; Valor nutritivo; Recém-nascido prematuro.

## RESUMEN

**Objetivo:** evaluar y comparar el contenido energético de la leche humana cruda y la leche humana procesada de recién nacidos prematuros. **Método:** Se recolectaron 68 muestras de leche por ordeño manual y el procesamiento se realizó en el Banco de Leche Humana. El valor energético se obtuvo mediante cálculos matemáticos específicos. **Resultados:** se analizaron 32 muestras de leche humana cruda y 28 de leche humana pasteurizada. El porcentaje medio de nata fue  $3,84 \pm 1,3\%$  y una mediana de  $4,5\%$  en leche pasteurizada, y en leche cruda  $8,9 \pm 4,6\%$  y  $8,53\%$ . El contenido energético medio y mediano de la leche cruda fue de  $78,91 \pm 15,46$  kcal/100 ml y  $81,07$  kcal/100 ml y de la leche pasteurizada de  $65,18 \pm 9,67$  kcal/100 ml y  $61,8$  kcal/100 ml. **Conclusión:** la leche humana cruda tiene un mayor porcentaje de contenido graso y energético que la leche pasteurizada, pero aun así es recomendada por sus beneficios protectores.

**DESCRIPTORES:** Leche humana; Valor nutritivo; Recien nacido prematuro.

## INTRODUCTION

Human milk (HM) is considered a complete food for infants from birth up to six months of age and in a complete form up to two years of age. Due to its unique composition, HM is able to provide proteins, lipids, carbohydrates, vitamins, trace elements, growth factors, hormones, enzymes, immunoglobulins, and other components that contribute to immune protection of newborns (NBs) and healthy growth and development.<sup>1</sup>

The composition of HM is complex and dynamic, and several important methodological considerations are vital when exploring the association between human milk composition and weight gain. Weight gain is essential for adjustment to extrauterine life where there is adaptation of systems for regulation and maintenance of blood pressure, blood glucose, and body temperature, thus requiring increased caloric expenditure.<sup>2</sup>

Newborns under 37 weeks gestation – known as preterm newborns (PNEB) – have lower calorie reserves, a situation that is offset by the breast milk produced by the mother, which is physiologically adapted to meet the needs of babies born prematurely. In general, preterm NBs may also have low birth weight (BW) for gestational age. Thus, the lower the birth weight, the smaller the nutritional reserve, thus preventing the maintenance of basal metabolism.<sup>2,3</sup>

In addition to rapidly exhausting their reserve and nutrient limits, PIs can present clinical complications that increase energy expenditure and their nutritional needs. However, despite the adversities faced by PIs, breastfeeding is considered capable of meeting nutritional needs, reducing the adverse effects of hos-

pitalization, offering better antioxidant protection, and reducing the incidence of infections and other complications.<sup>1,4</sup>

Given the numerous benefits of HM for infant growth and development, when breastfeeding cannot be promoted in Neonatal Intensive Care Units (NICU), raw human milk (RHM) milked from the mother's breast and immediately administered to the NB is used. The mother's own breast milk is the first choice for NBs, however, mothers who have given birth prematurely often experience significant difficulties in breastfeeding their babies, and one of the alternative forms of nutrition is donated breast milk.<sup>5,6</sup>

The processing of donated milk can impact the fat content of the HM. The crematocrit technique is a simple method to estimate the fat and energy content of human milk based on centrifugation. The percent cream or "crematocrit" is linearly related to fat and energy content. The evaluation of the energy content of the HM is essential, because the milk is distributed according to the caloric needs of each NB.<sup>7,6</sup>

Considering the high nutritional demand required by PIs and that the analysis of the composition of milk regarding energy and fat content provides individualized adjustments for neonatal nutrition, this study aimed to evaluate and compare the energy content of RHM and processed human milk (PHM) offered to PIs admitted to a NICU.

## METHODS

In the period from July 2019 to March 2020, samples of RHM and PHM administered to PIs who were children of mothers who were part of the parent project: Influence of heavy metals and pesticides on adverse pregnancy outcomes in the state of Rondô-

nia, approved by the Research Ethics Committee of the Federal University of Rondônia (UNIR) (CAAE 00961618.2.0000.530 and opinion no. 3.036.366), were collected.

Puerperae selected for collection were those whose babies were admitted to the UTINEO of the Hospital de Base Dr Ari Pinheiro in Porto Velho-RO. Mothers were approached in the family living room of the NICU. Inclusion criteria were those related to the matrix project, namely: mothers who had lived in Rondônia for at least two years and had a single pregnancy. For this study, lactating mothers as of the 14th day postpartum were also selected. Samples with dirt and/or foreign bodies were excluded.

The samples of HM were collected by manual milking of the breast in an environment designed for this purpose. Considering that the samples came from the matrix project, both anterior and posterior milk were included, the milking and pasteurization procedures followed the protocols established by the Brazilian Human Milk Banks Network.

For energy content analysis, 1ml of milk was pipetted from the samples collected from the parent project. The bottles used for collection were sterile. The 1mL content was placed in a test tube in a small PVC rack and placed in a 40° C water bath for 15 minutes. After this time had elapsed, three 75 microliter aliquots of each of the milked human milk samples were filled.

The ends of the tubes were sealed with capillary sealing putty and arranged in the centrifuge. Centrifugation time averaged 15 minutes. Each capillary was then read after centrifugation. Two columns were observed: the cream column at the top and the serum column at the bottom. The amount of cream was measured with a pachymeter. From the values obtained the energy value was determined by means of specific mathematical calculations as follows:

Evaluation of the cream content:

$\text{Cream column (mm)} \times 100 \div \text{total column (mm)} = \% \text{ cream content}$

Evaluation of fat content:

$(\% \text{ cream} - 0.59) \div 1.46 = \% \text{ fat content}$

Calculation of total energy content:

$(\% \text{ cream} \times 66.8 + 290) = \text{kcal/liter}$

At the end of the process, the value obtained and its final average were noted. For the descriptive analysis of the data we used mean, standard deviation, and median and standard deviation. Box-plot graphs were used to represent the data variation in the two observed groups.

## RESULTS

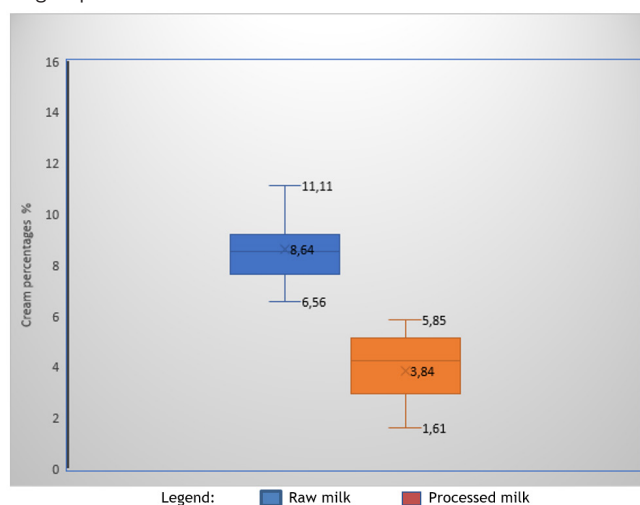
Sixty-eight samples of HM were collected from mothers whose neonates met the inclusion criteria of the matrix project; however, eight samples were excluded during the analysis process: three because they presented significant discrepancies between the heights of the cream columns, and five other samples because of poorly defined cream columns. After exclusion, 60

HM samples remained, distributed as follows: 32 RHM and 28 PHM milk samples.

All neonates included in the study were being fed both types of milk, i.e., raw and pasteurized milk. Although it was not the purpose of this study, it was observed that the low milk production requiring pasteurized milk supplementation was due to breastfeeding related problems and other stressors reported by the mothers.

The mean, standard deviation and median of the percent cream were as follows: in the processed milk group: mean  $3.84 \pm 1.3\%$ ; median 4.5%; in the raw milk group: mean  $8.64 \pm 1.5\%$ ; median 8.53% (Figure 1).

**Figure 1** – Distribution of the values of the percentage of cream in the groups studied. Porto Velho, RO, Brazil, 2020.



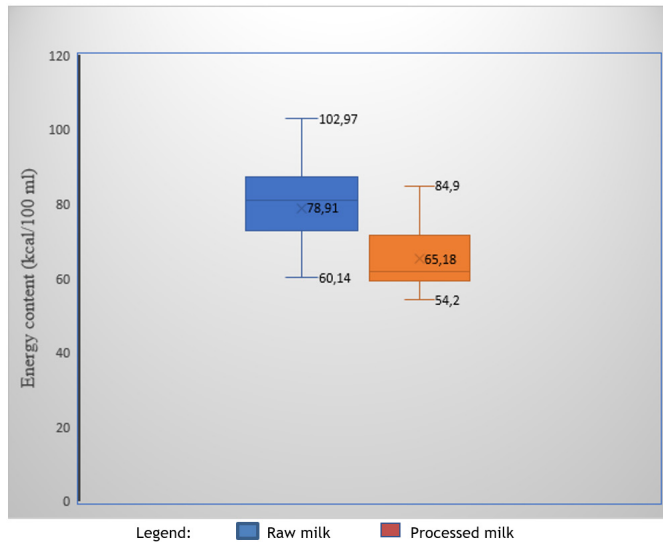
The mean, standard deviation, and median of the calculated energy content were as follows: in the processed milk group: mean  $65.18 \pm 9.67$  kcal/100 ml; median 61.8 kcal/100 ml; in the raw milk group: mean  $78.91 \pm 15.46$  kcal/100 ml; median 81.07 kcal/100 ml (Figure 2).

## DISCUSSION

Creamatocrit analysis is useful for estimating whether there is adequate energy component to meet the needs of premature infants in the hospital environment. The results showed that there were differences in the percentage of cream and energy content between the two types of milk samples analyzed. The calorie content of RHM was higher when compared to PHM. Using as reference the classification proposed by a previous study<sup>8</sup>, the RHM was considered hypercaloric ( $>71.1$  kcal/100ml) and the LHP normocaloric ( $>58$  kcal/100ml and  $<71.1$  kcal/100ml).

Differences in energy content between RHM and PHM have also been reported in other studies. An analysis of 57 HM samples found significant reductions in mean fat and protein concentrations (5.5 and 3.9%, respectively) after milk processing.<sup>9</sup> Reduction of energy content (2.8%) was also demonstrated in a study that analyzed a total of 34 HM samples.<sup>10</sup> Subsequently,

**Figure 2** – Distribution of energy content values in the groups studied. Porto Velho, RO, Brazil, 2020.



another study analyzed 257 HM samples<sup>11</sup> and found an 18% decrease in caloric value after pasteurization.

In larger samples (462), these differences were also shown to be significant between the means in the processed milk group (mean  $53.6 \pm 7.2$  kcal/100 ml; median 53.6 kcal/100 ml) and the raw milk group (mean  $85.9 \pm 27.9$  kcal/100 ml; median 78.5 kcal/100 ml)<sup>5</sup>. Other studies also suggest changes in other physicochemical properties after pasteurization, such as protein content, pH value, and bioavailability of vitamins and mineral salts.<sup>7,12-13</sup>

However, the nutritional composition of donated breast milk may differ from that of breast milk for many reasons, such as differences in maternal characteristics (stage of lactation and maternal diet); inconsistency in milk collection methods (including incomplete breast extraction leading to fat loss); and the impact of milk banking practices, which involve milk storage processes and transfers to multiple containers.<sup>5-6,14-15</sup>

During the entire course of the donated milk (pre-storage, thawing, pasteurization, refreezing, thawing, and heating) until it reaches the NB, significant energy losses may occur, especially in lipids, which are the main caloric source that make up the HM.<sup>5,12</sup> However, this reduction, although significant, can be considered clinically irrelevant, especially because donated milk usually comes from puerperal women who have had children at term, which is naturally a milk with lower caloric value when compared to that from puerperal women who have had preterm children.<sup>16</sup>

Despite the caloric difference between RHM and PHM, it is important to emphasize that the feeding strategy indicated for PIs when the mother's milk is not available is still the HM, which even after pasteurization, continues to have its own nutritional and protective properties for the needs of a newborn. Furthermore, PHM when associated with breast milk contributes to reduce the incidence of necrotizing enterocolitis, late onset sepsis, bronchopulmonary dysplasia, and improves feeding tolerance.<sup>17-19</sup>

However, when considering the changes in the caloric profile of HM after pasteurization process and the importance of higher lipid content for growth and development of PIs, researchers from Mato Grosso do Sul 11 recommend strategies that seek to favor the offer of milk milked from the mother herself for the NB, such as the implementation of a collection station within the NICU itself, in order to stimulate the supply of HL for hospitalized children and contribute to weight gain.

This is due to the fact that the HM has proven to have a beneficial effect in preventing comorbidities in PIs when compared to infant formulas that have vegetable lipid sources in their composition and have different structures from the fat of the HM, which impairs the absorption of nutrients.<sup>20</sup>

During the present study, great difficulty in maintaining breastfeeding was observed. This fact may be related to the adversities experienced during the hospitalization period that vary from factors inherent to the puerperal woman and others related to the environment and routines established during the stay of the newborn in the neonatal unit.<sup>1</sup>

These physical and emotional difficulties can directly influence milk production and, consequently, favor early weaning.<sup>21</sup> Although the maintenance of breastfeeding is not the main scope of this study, some difficulties observed during the collections – such as being from other cities, having other children, difficulty in locomotion and transportation to the hospital, lack of family support, and concern with work activities to maintain their livelihood – have shown to have an influence on the supply of milk to PIs.

In addition to the factors already mentioned, the occurrence of the new coronavirus (SARS-CoV-2) and other respiratory syndromes had a major impact on the frequency of milking by mothers accompanying their infants in the NICU, which is an additional worrying factor regarding the supply of human milk for PIs requiring intensive care.

## CONCLUSION

The use of LH is essential for RNTPs requiring intensive care. In general, preterm infants have difficulty in sucking adequately directly from the mother's breast and, in this scenario, the ideal is that the RN be offered the mother's own RHM. In view of the difficulties faced by mothers of preterm infants, which lead to lower milk production, the offer of BHM is recommended. Although this type of milk may suffer energy losses during the handling process, it is recommended due to its protective benefits.

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