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BIOECONOMY IN THE DAIRY INDUSTRY: APPLICATION OF BUTTERMILK IN KEFIR PRODUCTION

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Introduction

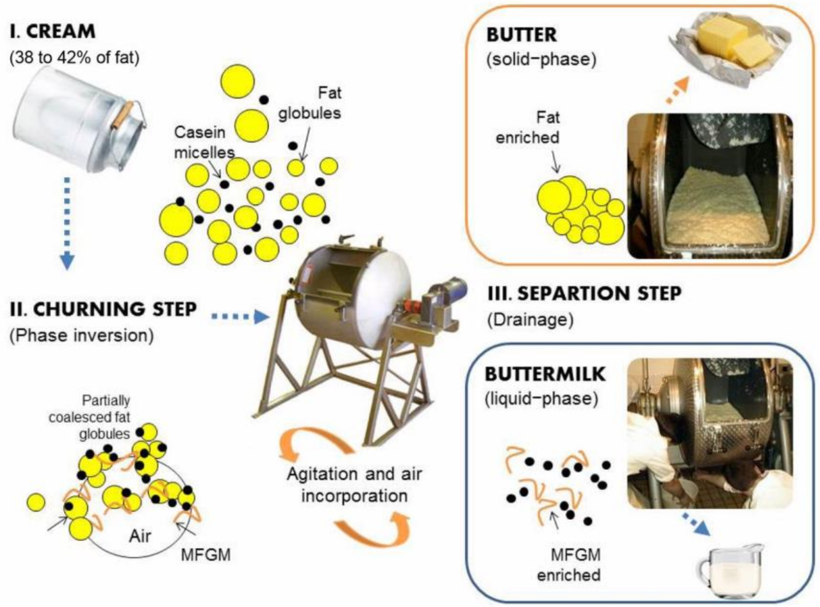
Whey

Buttermilk

- ❑ Buttermilk (≠ whey) is still underutilized in Brazil

WHAT IS BUTTERMILK?

- ❑ It is a coproduct produced when cream is transformed into butter.
- ❑ It contains milk proteins, lactose, minerals, as well as material from the milk fat globule membrane (MFGM).



Introduction

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Buttermilk

Bioactive properties:

❑Alzheimer and cancer

Technofunctional properties:

❑Emulsifying and foaming

→

Integration of sustainability and health

Introduction

KEFIR:

- The consumption of kefir has gained increasing attention.
- Kefir is a fermented beverage produced from a symbiotic mixture of microorganisms (kefir grains).
- Lactic acid bacteria are a significant part of the microbial composition of kefir and contribute to its health-promoting effects, such as:
  - ✓ Cancer
  - ✓ Cardiovascular diseases
  - ✓ Diabetes
  - ✓ Obesity
  - ✓ Kidney diseases
  - ✓ Modulation of the immune system and intestinal microbiota

Objectives

General objective:

- ✓ This study aimed to evaluate the use of different proportions of whole milk and buttermilk (100:0; 80:20; 60:40; 40:60; 20:80; 0:100) for kefir production, with the goal of adding value to this coproduct and promoting bioeconomy principles in the dairy sector.

Specific objectives:

- ✓ Develop different kefir formulations with partial replacement of whole milk by buttermilk;
- ✓ Evaluate the increase in kefir grain biomass over 21 days;
- ✓ Determine the proximate composition of the developed beverages;
- ✓ Analyze the water-holding capacity and syneresis in the developed kefirs.

Methodology

Kefir production

Whole milk

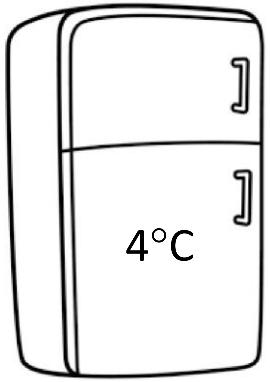
Buttermilk

+

Kefir grains

Incubation – Fermentation for 12–48 h at 25 °C.

Separation of kefir grains



Methodology

Growth of kefir grain biomass

- ❑ Kefir grains fermented for 24 hours over a period of 21 days.
- ❑ Every 24 hours, the kefir grains were washed with filtered water and allowed to dry for 10 minutes.
- ❑ Finally, the grains were weighed using an analytical balance.

Centesimal composition

- ❑ Was determined according to the AOAC methodology.

WHC

- ❑ Approximately 20 g of the sample were weighed
- ❑ Centrifuged at 4500 × g for 10 min at 4 °C.

$$WHC\ (\%) = 1 - \frac{mass\ of\ supernatant\ (g)}{mass\ of\ sample\ (g)} \times 100$$

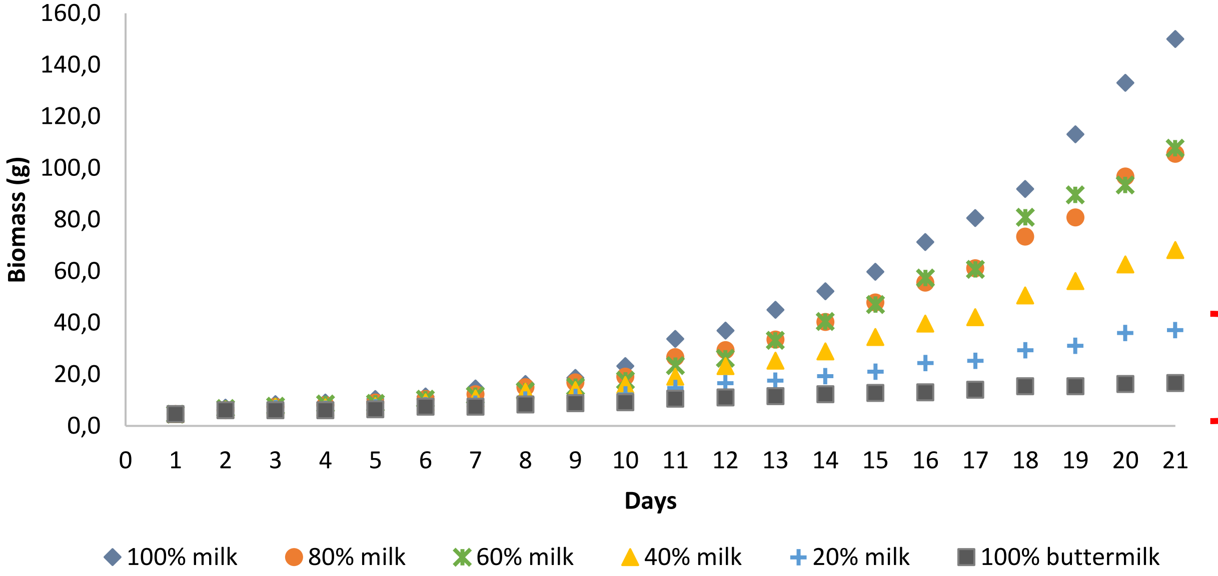
Syneresis

- ❑ Approximately 10 g of the sample were weighed
- ❑ Centrifuged at 500 × g for 20 minutes at 4 °C

$$Syneresis\ (\%) = \frac{mass\ of\ supernatant\ (g)}{mass\ of\ sample\ (g)} \times 100$$

Results and discussion

Biomass



150.00 g, 105.50 g, and 107.60 g, respectively.

37.11 g and 16.62 g, respectively.

Figure 1 : Increase in biomass over 21 days.

The biomass results show that whole milk provides more favorable nutritional conditions for the development of kefir grains.

Table 1: Equations and R^2 corresponding to the increase in biomass.

Formulations	Equations	R^2	Growth rate (g/day)
100% milk	$y = 4.468e^{0.171x}$	0.9961	7.4
80% milk	$y = 4.225e^{0.158x}$	0.9945	5.3
60% milk	$y = 4.139e^{0.159x}$	0.9882	5.3
40% milk	$y = 4.303e^{0.135x}$	0.9948	3.3
20% milk	$y = 4.466e^{0.103x}$	0.9952	1.7
100% buttermilk	$y = 4.921e^{0.062x}$	0.9827	0.6

Results and discussion

Proximate composition

Table 2. Composition of kefir formulations produced with different proportions of whole milk:buttermilk.

	COMPOSITION (%, w/w)				
Formulations	**Moisture**	**Protein**	**Lipid**	**Ash**	**Carbohydrate**
100% milk	89.70^{e}	3.43^{a}	3.05^{a}	0.48^{ab}	3.34^{a}
80% milk	91.55^{d}	3.03^{b}	2.50^{b}	0.54^{a}	2.42^{ab}
60% milk	92.58^{cd}	2.72^{bc}	2.45^{b}	0.51^{a}	1.67^{bc}
40% milk	93.49^{c}	2.50^{cd}	1.70^{c}	0.43^{ab}	1.87^{b}
20% milk	94.65^{b}	2.17^{de}	1.12^{d}	0.40^{ab}	1.65^{bc}
100% buttermilk	96.57^{a}	1.89^{e}	0.55^{e}	0.35^{b}	0.63^{c}

Values with different superscript letters are significantly different ($p < 0.05$).

Moisture

Protein and lipid

Higher buttermilk concentration

Milk

Protein (%, w/w)	**Lipid** (%, w/w)
3.4	3.1

Buttermilk

Protein (%, w/w)	**Lipid** (%, w/w)
1.92	0.5

Results and discussion

WHC and Syneresis

Table 3. Changes in water holding capacity and syneresis of kefir during 9 days of storage at 5 °C.

WATER-HOLDING CAPACITY					
Formulations	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**
100% milk	48.47bA	51.97abA	53.37aA	54.37aA	53.92aA
80% milk	38.13bB	43.12aB	42.53aB	44.70aB	43.60aB
60% milk	31.48cC	33.30bC	34.03bC	36.08aC	34.64abC
40% milk	27.03cD	29.13bD	29.67abD	31.00aD	30.93aD
20% milk	20.82bE	22.92aE	23.53aE	24.02aE	23.77aE
100% buttermilk	16.27aF	18.10aF	19.17aF	19.62aF	19.73aF

SYNERESIS					
Formulations	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**
100% milk	32.70aF	31.00abF	32.77aF	32.78aF	30.36bF
80% milk	44.07aE	43.13aE	44.70aE	44.03aE	43.80aE
60% milk	53.60aD	54.07aD	52.23aD	52.74aCD	52.11aD
40% milk	60.07aC	59.23aC	59.63aC	58.85aBC	56.70aC
20% milk	67.43aB	67.67aB	67.70aB	64.47aB	66.16aB
100% buttermilk	73.87aA	73.67aA	73.43aA	73.60aA	75.03aA

WHC decreased with increasing buttermilk

- ❑ 100% leite (52.42%)
- ❑ 80% (42.42%)
- ❑ 60% (33.91%)
- ❑ 40% (29.55%)
- ❑ 20% (23.01%)
- ❑ 0% leite (18.58%)

Over time, all formulations will show an increase in WHC.

Syneresis increased proportionally with buttermilk content

- ❑ Ranging from 31.92% (100% milk) to 73.92% (100% buttermilk).

Overall, over time, all formulations showed a decrease in syneresis.

Conclusions

- ✓ Partial replacement of milk by buttermilk in kefir production shows potential up to the 40% level.
- ✓ The inclusion of buttermilk contributes to the valorization of an underutilized co-product, promoting sustainable alternatives aligned with bioeconomy principles in the dairy industry.
- ✓ More studies are needed.

Acknowledgments

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INOVAÇÃO E PESQUISA

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Obrigada!!   Thank you!!