Production And Quality Evaluation Of Imitation Yoghurt From Blends Of Cow Milk And Cashewnut Milk (Anacadium Ocidentale)

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Abstract: In recent years, research efforts in the developing countries have been geared towards the improvement of protein quality of foods using blends of legumes and edible nuts which is considered a nutritionally balanced product. The present study was aimed at finding local substitute for cow milk based with high protein content of a well-balanced amino acid composition and high digestibility using cashew nut milk. Yoghurt samples were produced from blends of cashew nut milk and cow milk using Streptococcus thermophillus and Lactobacillus bulgaricus as starter cultures. Ratio of cashew nut milk to cow milk was 90%:10%; 80%:20%; 70%:30%; 60%:40%, 50%:50% and 100% whole cow milk as control and were subjected to proximate, physico-chemical, mineral, microbiological and organoleptic assessment. The result of chemical analysis revealed that the most acceptable yoghurt was sample B(90;10%; whole cow milk: cashewnut milk) with moisture content, of 86.67±0.01%, protein contents, 3.25±0.02%, ash content,0.44±0.04%, fat content, 3.18±0.01%, lactose,6.77±0.02% which compares well with standard yoghurt. Also, the value of TTA, 1.36±0.001%, pH, 4.40±0.001, sugar level, 18.31±0.001% and relative density, 1.017±0.001. Yoghurt produced from whole cow milk did not differ organoleptically ($p>0.05$) from those produced cashew nut and cow milk in all quality attributes (appearance, mouth feel, taste and overall acceptability) but differ significantly (($p<0.05$) and microbiological examination revealed a tolerable level for all the samples. This study has shown that it is feasible to produce acceptable and affordable yoghurt-like product from cashew nut and cow milk which could be of economic significance since cow milk is relatively expensive and highly perishable

Keywords: Yoghurt, fermentation, cashew nut, cow-milk, starter culture,

1.0 Introduction

Yoghurt is a cultured and fermented food product obtained through controlled fermentation of milk (anaerobic fermentation) by means culture of lactic acid bacteria to produce a characteristic mild clean lactic flavour and typical aroma which are classified as pro-biotic [1, 2, 3]. Conventionally, yoghurt is produced from cow milk and starter culture containing lactobacillus bulgaricus and streptococcus thermophillus [4] and is believed to possess nutritional and therapeutic properties [4, 5]. Yoghurt is therefore said to be the dairy product produced by bacterial fermentation of milk. These microorganism convert milk lactose into lactic acid and make milk sour. The popularity of yoghurt is due to its characteristics, the pleasant aromatic flavour, thick creamy consistency and its reputation as food associated with good health [6]. Yoghurt is nutritionally rich in protein, calcium, riboflavin, vitamin B_6 and vitamin B_{12}. It has more nutritional qualities beyond that of milk in vitamins content for its digestibility. It is also used as sources of calcium and phosphorus. It is believed that yoghurt has valuable "therapeutic properties" and help curing gastrointestinal disorders [7]. Yoghurt may aid digestion, ease diarrhea, boast immunity, protect against cancer [8]. Yoghurt can be presented in large varieties ranging from set or stirred yoghurt, plain, partly skimmed or skimmed to sweetened and flavoured forms [9] (Imele and Atemnkeng, 2001). In Nigeria, many people regularly take yoghurt either as a dessert, snack or as a pro-biotic food drink to aid digestion and to re-establish a balance within the intestinal microflora. The substitute that is usually employed in yoghurt production is evaporated whole milk or skimmed solid or fresh milk from cow. Although, this substrate produces good quality yoghurt, there are certain constraints that hinder average or low income earner to purchase this product which may be as a result of relatively expensive nature of substrate when compared with other substrate which have the same potential to give the same results as seen in cow milk. Also, strict vegetarian are also in their quest for probiotic yoghurt when there is the confinement to only animal base yoghurt. In view of the scarce milk supply in various countries and the ever increasing gap between the requirement and population, effort have been made over the years to develop alternative milk-like product from plant source[10,11]. It is therefore, of great importance to find out the feasibility of using cashew nut milk as

substrate for yoghurt production. Therefore, this present study is aimed at finding local substitute for milk based product with high protein content of a well balancing amino acid composition and high digestibility. Research efforts in the developing countries have been geared towards the improvement of protein quality foods using blends of legume and cereal which is considered a nutritionally balanced product.

2.0 Materials and Methods

2.1 Materials: Cashew kernel and cow-milk were purchased from local market in Lagos. The organism (Lactobacillus bulgaricus and streptococcus thermophillus) in the starter culture used for the fermentation was obtained from a local market in Yaba. Other equipment and materials utilized were of analytical grade and food standard, all of which were obtained from Food Technology Department, YABATECH, Lagos.

2.2 Method

2.2.1 Production of cashew nut milk

Cashew nut kernels were sorted to remove dirt and extraneous materials. The sorted kernels were washed to remove all the adhering dirt and contaminants. The kernels were then blanched to destroy the microorganisms and antinutritional factors. The blanched kernels were then soaked in 0.05% sodium bicarbonate solution for one hour to reduce cooking time and for taste improvement. The soaked kernel were drained, dehulled to remove testa, rewashed and wet-milled. The wet-milled kernel were then strained (sieved) and boiled for 20mins while constantly removing the scum. It was then cooled and packaged in standard yoghurt plastic bottles.

2.2.2 Preparation of cow-milk

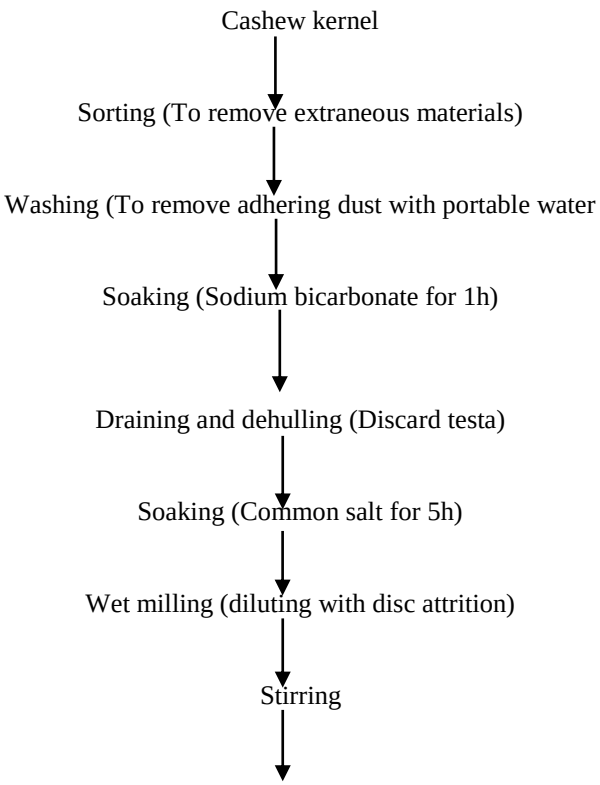
100g of milk was reconstructed with 10L of portable water.

2.2.3 Production of yoghurt from blend of cashewnut and cow-milk

The yoghurt was produced from the mixture of cashew milk and the reconstituted cow-milk using ratio (100:0) as the control; (90:10), (80:20), (70:30), (60:40) and (50:50) in v/v as presented in Table 2. The mixtures were inoculated with a starter culture stirred properly and kept at a temperature of 43^0C for 5 h. 0.2kg of Adamly starch and 0.011g of Ricadan FS were added to the samples. These act as stabilizers and emulsifiers to add to the nutritional value of the main ingredient together without any separation. 0.45kg of sugar was added to the mixture to sweeten and the samples were stored at a temperature between 1^0C and 6^0C

Table 1: *Blends of cow milk and Bambara-nut milk*

Sample	Cow-milk (%)	Cashew-nut milk (%)
A	100	0
B	90	10
C	80	20
D	70	30
E	60	40
F	50	50



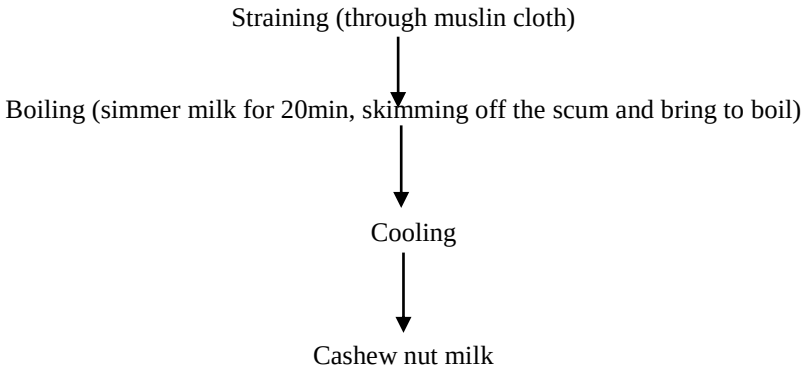


Fig.1: *Flowchart for the production of cashew-nut milk [12]*

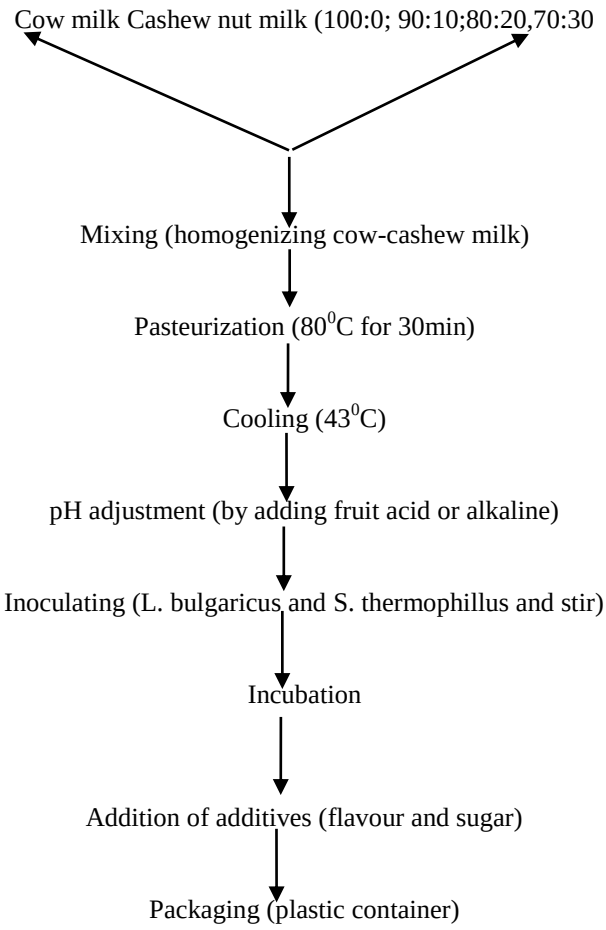


Fig.2: *Flowchart for the production of cow-cashew-nut yoghurt [12]*

2.3 Chemical analysis: The moisture, ash and total solid contents of the yoghurt were determined using the methods of [13]. Fat content was determined following the method described by Werner-Schmid. Protein was evaluated using formol titration method. The pH of the samples were determine using Dye unicon pH meter (Model, 290 MK2) while the titratable acidity was determined using the method described by [14]. Carbohydrate was calculated by difference [13] (AOAC, 2007). Energy conversion factors given by [15] were used in calculating the caloric value of the nutrients.

2.4 Free Fatty acids

Free fatty acid was analysed by weighing 5g of a well-mixed melted fat sample and adding (25ml) of 95% Ethanol/Ether (1:1). The mixture was titrated with 0.1N NaOH using phenolphthalein as indicator until a pink colour persisted for 30 seconds (Pearson, 1976).

2.5 Microbial examination: Total viable count of soy yoghurt and soy corn yoghurt were determined using pour plate technique. (0.1 mL) of the appropriate dilution was placed on nutrient agar plates. The plates were incubated at 35ºC for 48 h and colony forming units per g sample (cfu/g) was estimated. For mold and yeast count; the

above procedure was repeated using potato dextrose agar and incubation was done at 25ºC for 72 h.

2.6 Sensory evaluation: The prepared yoghurt samples were presented to an untrained 10-member panel of judges who were familiar with the consumption of yoghurt. The samples were assessed for colour, flavor, viscosity, taste and overall acceptability using a nine-point hedonic scale, where 9 indicated "like extremely" and 1 indicated "dislike extremely". Each panelist was provided with enough privacy to avoid biased assessment.

2.7 Statistical analysis: Data obtained were analysed statistically using Analysis of variance (ANOVA) and means were separated using the Least Significant Difference (LSD) according to [16].

3.0 Results and Discussion

3.1 Proximate composition

Yoghurt is a fermented milk product whose typical flavour in the form of sour taste is attributed to the production of lactic acid and diacetyl from carbohydrate by the fermenting organisms [5]. The result of the proximate composition of the imitation yoghurt revealed the moisture content of the sample ranged between 78.05-88.67% with sample B (ratio 90:10) having the highest moisture content (Table 1). These values fall within the moisture content for standard yoghurt with values of 85-95% [17]. The proximate content varies between the values of 2.21-2.89%. The values are within the recommended ranged for standard yoghurt which all samples fall within the range. The combination of cow milk with cashew nut milk improved the crude protein value (2.65 to 3.29) substantially. Similarly, the crude fat content (%) ranged from 3.25(cow milk) to 3.58(cashew nut + cow milk). Egan [19] reported that commercially prepared yoghurt should have the following minimal proximate compositions (%): protein, 3.5; fat, 3.25, and moisture content, 87.7. The results obtained in this study are in agreement with those recommendations by these authors as well as those obtained by [19] in peanut milk-yoghurt and [20] in coconut-tigernut yoghurt and [9]. This higher protein content could be due to the processing techniques used to prepare the yoghurt which might help breakdown of lipocytes to release fat and protein [21]. Fat content is one of the most important quality factors of yogurt or fruit yogurt. It depends on milk quality, amount of fruit pulp, fruit variety and other treatments. The fat content of a food sample can affect its shelf stability. This is because fat can undergo oxidative deterioration, which leads to rancidification and spoilage. Hence a food sample with high fat content is more liable to spoilage than one with a lower fat content [22]. Protein Advisory group (1972) recommends fat content of a weaning food should be not more than 10% due to oxidative deterioration. But in the formulated diets as yoghurt and flour mixture keep separately total fat content of 12% will not affect for its shelf life. In the current study, soybean and yoghurt were used as the main fat suppliers. Soy bean oil agree with the recommendations of [23] that vegetable oils can be included in foods meant for infants and children, which will not only increase the energy density, but also be a carrier for fat soluble vitamins and provide essential fatty acids. Oil seeds, edible tree nuts and cereals contain unsaturated fats [21] which does not increase the cholesterol in the blood hence can be recommended for children. The ash content of the products indicates the mineral content of the products. Acceptable ash content of weaning foods which given by the Protein Advisory Group recommendations (1972) should not exceed 5%. Formulated foods studied in the current study were within this limit as well. Acceptable fiber content of weaning foods should not exceed 5% according to the Protein Advisory Group Recommendations (1972) since when the fiber content is high it decreases the digestibility of the particular food. The crude fiber content of the evaluated formulated foods were within this acceptable range. The dietary fiber fractions of all weaning foods were comparatively low due to the incorporation of de-hulled legumes [24].

Table 1: *Proximate composition of yoghurt produced from blend of cashew nut and cow-milk*

Sample	A	B	C	D	E	F
Moisture %	78.05	88.67	88.54	88.44	88.67	88.25
Protein %	3.21	2.65	2.80	2.98	3.25	3.29
Fat %	3.25	3.18	3.25	3.28	3.55	3.58
Ash %	0.45	0.44	0.45	0.48	0.52	0.54
Lactose	6.31	6.77	6.75	6.80	6.85	6.88

3.2 Physico-chemical properties

The physicochemical analysis results (Table 2) showed that the pH of the yoghurt samples produced ranged from 4.22 to 4.35 which was in agreement with the results of other workers [25], Sanful [1] who reported the same for the production of yoghurt from coconut. The addition of lactose to milk prior to fermentation was necessary to enhance the souring ability of the lactic, since lactose is the fermentable sugar generally preferred by lactic acid bacteria. Also, the addition of lactose probably influenced the sugar content of all the products which were in a comparable ratio as observed in this study. pH values of yoghurt samples ranged between 4.40 and 5.18. TTA values of the yoghurt samples ranged between 1.46 and 1.58%. The pH and TTA (%lactic acid) values obtained from this study differed from the findings reported by [20] who obtained pH 3.9 to 4.1 and TTA (% lactic acid) 0.5 to 0.75 but similar to the findings of [11] who obtained pH 4.2 and 5.3. It was observed in this study that pH values of yoghurt decreased with increased acidity (TTA).This trend could be attributed to the fermentation process. This is because, during fermentation, microorganism uses sugar such as lactose and glucose for their metabolic activity and in the process secret acids as by-products. Yoghurt production is a biological process and cooling is one of the most popular methods used to control the metabolic

activity of the starter culture and its enzymes. Lactic acid bacteria show limited growth activity around and below 10^0C and increased growth activity above 10^0C. The main aim of cooling is to drop the temperature of the coagulum from 45^0C to less than 10^0C as quickly as possible to control the final acidity of the product [3]. The relative density of the yoghurt samples was range between 1.015 to 1.034 with the whole cow milk yoghurt having the least and sample F(50:50) having the maximum value. This finding is similar to the finding reported by [1, 9]. This indicated that the whole cow milk yoghurt contained more water than the cashew nut yoghurt. However as titratable acidity increased, the pH decreased as a function of fermentation time. Acid production in the medium depends on the growth of microorganisms and their ability to ferment the available carbohydrates. Peroxide value is defined as the milli-equivalents (mEq) of peroxide per kilogram of fat. It measures the amount of peroxide or hydroperoxide groups (initial products of lipid oxidation) present in oil or fat. Peroxide value (PV) of yoghurt sample ranged between 10.48 to 11.04meq/kg. Sample C (80:20%) had the least peroxide value while cow milk yoghurt had the highest value. Peroxide value monitors the development of rancidity through the evaluation of the quantity of peroxide generated in the products. Fresh oils usually have peroxide value is between 20 and 40meq/kg [3,29] (Onwuka, 2005; Adgidzi and Abu, 2014)

Table 2: *Physicochemical properties of yoghurt produced from cow-cashew nut milk blends*

Sample	**A**	**B**	**C**	**D**	**E**	**F**
Fixed Acidity	0.68	0.65	0.55	0.58	0.60	0.66
TTA (%)	1.46	1.36	1.35	1.50	1.55	1.58
Ph	4.35	4.30	4.28	4.25	4.22	4.20
Sugar	14.2	18.31	18.66	18.96	19.31	19.55
Relative density	1.015	1.017	1.021	1.026	1.030	1.034
Peroxide value (meq/kg)	11.04	10.58	10.50	10.48	10.55	11.0

3.3 Mineral composition

There are gradual increase in calcium, magnesium, sodium and manganese as the proportion cashew nut increases in the blend (Table1). This indicates that cashew nut milk can be a potential source of mineral. However, the values for iron, zinc and phosphorus decrease in yoghurt with increase in the cashewnut milk content. This indicates that attempt for fortification will be necessary. It has been reported that magnesium is an activator of many enzymes systems and maintains the electrical potential in nerves [30] (Ferro, 1987). Calcium in conjunction with phosphorus, magnesium, manganese, vitamins A, C and D, chlorine and protein are all involved in bone formation [30] (Fleck, 1976). Calcium is also important in blood clothing muscle contraction and in certain enzymes in metabolic processes. Calcium, an important mineral required for bone formation and neurological function. Phosphorus is always found with calcium in the body both contributing to the blood. Sodium is a macronutrient and constitutes 2 percent of the total mineral content of the body. The mineral is vital in maintaining the body fluid volume, osmotic equilibrium and acid-base balance. Deficiency of sodium occurs during hot weather or as a result of heavy work in hot climate. The consumption of yoghurt fortified with cashew nut will complement the sodium in the body. The content of potassium can be utilized beneficially in the diets of people who take diuretics to control hypertension and suffer from excessive excretion of potassium through the body fluid.

Table 3: *Mineral composition of yoghurt produced from cow-cashew nut milk blends*

Sample	A	B	C	D	E	F
Calcium	0.061	0.081	0.072	0.073	0.082	0.085
Sodium	0.333	0.320	0.345	0.0301	0.280	0.0301
Magnesium	0.044	0.0461	0.0401	0.0441	0.0404	0.0440
Iron	0.0221	0.0199	0.0212	0.0194	0.0190	0.0190
Zinc	0.0112	0.0115	0.0117	0.0090	0.0091	0.0098
Potassium	0.312	0.322	0.346	0.324	0.321	0.312
Manganese	0.0122	0.0151	0.0112	0.0110	0.0105	0.0107
Phosphorus	0.0075	0.0071	0.0076	0.0068	0.0066	0.0072

3.4 Microbiological analysis

Table 4 shows the result of microbial analysis of the produced yoghurts samples. The total viable count appeared to be high because the microorganism used as starter culture are still present in the yoghurt samples but which would have stopped growing. All the samples were in the safe level of microbial load of standard. Microbiological analysis was conducted on the yoghurt samples to determine their wholesome for consumption. According to Sri Lankan Standards [26] for the yoghurt, acceptable coli form count is <1CFU/g. As shown in Table 4, samples A, B, C and E do not contain coliform bacteria. According to Turkish Standard Institute (TSI330), a maximum count of 10.0 cfu/g coliform is allowed in yoghurt. The presence of coliform in yoghurt is generally regarded as direct contamination of the food with faecal materials. The total viable count was insignificant since it was present in count range of 5.-7cfu/ml which is an acceptable standard in yoghurt [27]. All the samples showed low levels of yeast and mold counts. Levels above 10.0 cfu/g yeast and mold [28] are capable of producing toxic metabolites (aflatoxin) leading to food poisoning and can cause cancer of the liver in humans.

Table 4: *Microbial analysis of yoghurt produced from cow-cashew nut milk blends*

Sample	Total viable count (Cfu/ml)	Total mould/yeast count (Cfu/ml)	Coliform count (Cfu/ml)
A	7×10^4	8×10^4	NIL
B	6×10^4	6×10^4	NIL
C	7×10^4	6×10^4	NIL
D	7×10^4	6×10^4	NIL
E	5×10^4	8×10^4	NIL
F	6×10^4	7×10^4	NIL

3.5 Sensory evaluation

The results of the sensory properties of the yoghurt samples are shown in Table 5. Attributes such as colour, flavor, viscosity, taste and overall acceptability were evaluated by judges. It can be deduced that the cow-cashew nut yoghurt produced has no significant difference from one another even with the control sample. However, sample B (ratio 90:10) is most acceptable in term of taste, odour and overall acceptability judging from the mean values. The colour or appearance is the look and texture of the yoghurt as it is poured into a glass without labels for the panel to see and comment on. The panelists accepted the appearance of all the samples as good. There was insignificant difference between the mean values of the samples. Samples Band C produced a clean natural colour with smooth velvety appearance which agrees with acceptable standard described by [29]. There were no significant differences in terms of tastes for the three samples while sample A was rated low in terms of flavor and this is due to the beany flavor associated with soybeans. However, there are no observed differences in terms of overall acceptability for the samples except for the fact that there is high level of deterioration in cashew nut milk based products during storage [30]. The taste of the yoghurt is derived from the various acids present in the yoghurt during fermentation. The panelists gave their comments based on the tartness they felt in their mouth after tasting the yoghurt. The analysis of the sourness revealed that samples A and B were good. The composite samples E and F relatively had lower sourness or taste.

Table 5: *Consumer acceptability of yoghurt produced from cow-cashew nut milk blends*

Parameters	A	B	C	D	E	F
Colour	5.2a	5.7a	4.0a	4.4a	4.1a	5.1a
Sourness	4.8a	5.1a	4.6a	4.7a	4.1a	5.0a
Taste	5.4a	6.2a	3.2a	4.6a	3.1a	3.2a
Odour	4.8a	5.6a	3.3a	4.2a	4.2a	4.3a
Texture	5.0a	5.1a	4.6a	4.5a	4.8a	5.0a
Overall acceptability	5.1a	5.9a	4.0a	4.6a	4.1a	3.2a

3.6 Conclusion

Overall, the results obtained in this study indicate that it is feasible to prepare acceptable yoghurt-like products from cashew nut milk and cow milk at various substitutional levels which should be of economic significance since cow-milk is relatively expensive and highly perishable. More work should be carried out on how to extend the shelf life of the product stored at room temperature using chemical preservatives as most families either do not have refrigerators or do not have constant power supply. Creation of more awareness as there has always been a low patronage of locally produced food products relative to imported ones. Therefore, production of cashew nut-cow milk yoghurt which is highly consumed by Nigerians because of the availability of cashew nut in commercial quantity is another way of increasing the food value of the crop.

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