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Determination of Protein Value and Alcoholic Content in Locally Prepared Different Types of Cheka at Different Stages Using *CHNS* Elemental Analyzer and Specific Gravity *Methods*

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Abstract: Cheka, Errorota, Shurkuta and Pulla are a cereal and vegetable based beverages and foods which are typically consumed in south western parts of Ethiopia particularly in Derashe and Konso. In this article the qualitative tests of alcohol, protein and carbohydrate have investigated for different types of Cheka. The result obtained for all tests is positive result confirming the presence of alcohol, protein and carbohydrate in different types of Cheka. In addition to this quantitative analysis of nitrogen content, acidity and alcoholic content of traditionally prepared fresh and matured Cheka have determined using different methods including distillation with specific gravity methods for alcoholic content determination and CHNS elemental analyzer for protein content determination. CHNS elemental analyzer (also known as a carbon hydrogen nitrogen and sulphur analyzer) is a scientific instrument which is used to measure carbon, hydrogen, nitrogen and sulphur elemental concentrations in a given samples with accuracy and precision. The level of alcoholic content as well as level of acidity increases with the prolonged time of storage while specific gravity have shown to decrease with time of storage. Moreover, it has found that the level of protein is higher in Shurkuta and Pulla than that of Cheka and Errorota. To have all sorts of benefit from all types of Cheka it is better to consume it in its fresh stage. Finally the experimental results of the research have presented in tabular form.

Keywords: Cheka, Errorota, Shurkuta, Pulla, Alcohol Content, Protein Value, CHNS Analyser

1. Introduction

Alcoholic beverages are a part of human dietary culture and have an inseparable relationship with the life of mankind in history. The making and drinking of alcoholic beverages is way of enhancing the nutritional significance as well as social relationships for human beings. Exactly when mankind started to produce and consume alcoholic beverages is not known but beer is known to have been produced by the Sumerians before 7,000 BC (Before Christ), while wine has an unequivocally recorded history stretching back nearly 6,000 years, with the earliest evidence dating between 5,400 and 5,000 BC [1].

In Ethiopia, the traditional cereal based fermented beverages and foods are still prevailing in both rural and some urban communities [2]. Ethiopian traditional fermented foods and beverages, with no doubt are good functional foods and rich in various probiotics [3]. These fermented beverages are usually prepared from locally available materials using classical techniques, and their art is believed to pass down by cultural and traditional values to subsequent generations with the processing being optimized through trial and error. A wide range of cereal based traditional fermented foods and beverages are prepared in Ethiopia. Some of the known beverages are tella, borde, shamita, cheka, korefe, keribo, bukire, merissa,... etc. Tella is alcoholic, while the rest are considered to be low or non-alcoholic beverages.

Home brewed traditional alcoholic drinks, with their varied alcohol contents [4]. Cheka is the most commonly home brewed alcoholic beverage made from the mixture of maize, sorghum and malt in konso and Derashe southern Ethiopia. Cheka is widely consumed in the Konso and Derashe southern parts of Ethiopia by both adults and children. It is an important product because it is consumed as a low cost meal replacement and therefore provides a cheap food alternative for the low income group of consumers [5-6].

Cheka is a cereal and vegetable based fermented beverage which is consumed in Southwestern parts of Ethiopia mainly in Dirashe and Konso [7]. The ingredients and methods of preparation of Cheka in different places has a slight difference [8]. For instance, Brewers in Dirashe use the root part of "taro", where as producers in Konso only from main ingredients. In some localities, few households also use dried edible left overs of "injera, kitta or kurkufa" [7]. Today Cheka is found almost in all parts of southern Ethiopia due to its high energy supply to do hard works, easily availability of its ingredients and low cost [8]. People of all ages including infants, pregnant and lactating women drink Cheka [7].

Alcohols, aldehydes and carboxylic acids are the major contents of chemicals in cheka in addition to different nutrients including carbohydrates, proteins and lipids [8]. Traditional alcohols are more preferable by the people living in rural and small towns of Ethiopia, and its popularity is on the rise even in the big towns and cities. Drinking locally prepared alcoholic drinks is common in celebrating different festivities.

1.1. Statement of the Problem

In Ethiopia, Various works have been reported in fermented food analysis [9]. Particularly alcoholic beverages in different parts of Ethiopia including the data with regards to methanol, fuel oil and ethanol content of tella, areki and tej [10]. Indigenous fermented alcoholic beverages from different parts of the world are described [11-12].

According to literatures, Cheka fermentation has not received the scientific attention that it deserves. Studying the nutritional value, alcoholic content, and microbial dynamics of Cheka as well as understanding process variables and properties of raw materials during its preparations will help in making it as a commercially feasible enterprise. Being used for a long period of time, most native researchers have documented the indigenous processing methods and raw materials of Cheka [7].

Some works have also been done on nutritional value of Cheka qualitatively [8]. Even though the different studies conducted so far addressed the alcohol of Cheka, but there is no study did identify the quantitative percentage of alcohol and protein content that present in Cheka and also the information about the health effect of Cheka is limited, Therefore, the current study is aimed to determining the alcoholic and protein content of traditionally prepared Cheka at different stages in Konso, southern Ethiopia.

Alcohol is a predisposing factor for many cardiovascular disorders such as hypertension and gastrointestinal disorders. Therefore, knowing alcohol content of Cheka will help the consumers to abstain from excessively consuming it, in order to improve their health status. Furthermore, the result that will be obtained from the study will be helpful in filling the lack of scientific information catalogue and will also be used as a reference initiating further studies in the area of interest. Finally, the result obtained will be disseminated scientifically to provide essential information about Cheka to the rest of the world.

1.2. Objective of the Research

1.2.1. General Objective

Determination of Protein Value and Alcoholic Content in Locally Prepared Different Types of Cheka at Different Stages Using *CHNS* Elemental Analyzer and Specific gravity *Methods.*

1.2.2. Specific Objectives

a) Determine the level of alcoholic content of different types of Cheka by specific gravity method;
b) Determine the acidity of different types of Cheka that stored for long period of time;
c) Determine specific gravity of different types of Cheka at different stages;
d) Analyze a protein value in different types of Cheka and
e) Explain and describe the positive and negative impacts of Cheka to society.

2. Theoretical Background

In Ethiopia, different types of traditional alcoholic beverages such as Tella, Korefe, Shamit, katikala (or Araki), Borde and tej are produced and consumed [13]. Cheka is one of the Ethiopian traditional beverages, which is prepared from different ingredients. It is, by far, the most commonly consumed alcoholic beverage in Konso and Derashe, southern Ethiopia.

It is assumed that Konso's people is the primary origin of Cheka and have a long history with it, from which it is distributed to the neighboring areas around it [8] like Derashe, south Omo Zone (Jinka), Gamo Gofa Zone (Arba minch Konso safer), Walayta Sodo, Sidama Zone (Hawassa), burjji Wereda, Amarokelle woreda, Alle Wereda, Gujji Zone (Moyalle), Yabello, Gedieo Zone (Dilla), Hadiya Zone (Wachamo), Basketo special woreda, etc, due to its suitability to perform high energy requiring activities like farming and others. Konso peoples use Cheka as a drink as well as a food.

Derashe people's Cheka contains cabbage and Maringa leaf in addition to the common ingredients; while Konso's Cheka is prepared from common ingredients only [8]. But leaf part of "taro", cabbage and Moringa leaf used as a minor ingredients in Konso Cheka.

2.1. Nutritional Value of Cheka

In all societies, alcoholic beverages are used as powerful and versatile symbolic tools, to construct and manipulate the

social world as Cheka also do the same for Konso people. Cheka is a local drink which mostly used in Derashe and Konso woredas in the southern part of Ethiopia. Cheka is mainly prepared from cereals such as sorghum, maize and vegetables such as leaf cabbage, moringa (or Moringastenoptella), and decne [7].

These crops are common in the area because the condition and the type of soil around Konso and Derashe are suitable to grow those crops. Cheka is a mixture of maize, sorghum, water and malt. On the preparation, the ingredients pass through fermentation and other organic reactions and alcohols, aldehydes and carboxylic acids are the major contents of chemicals in Cheka. Maize, Sorghum and malt have different nutrients including carbohydrates, proteins and lipids [8].

2.2. Types of Cheka

Depending on the presence or absence of malt and methods of preparations there are four types of Cheka produced in Konso. Those are Cheka, Shurkuta, Errorota (Errera) and Madhota (pulla). In case of Cheka and Errorota (Erera) malt (dehota) used as a catalyst, while in case of Shurkuta and Madhota (pulla) wheat flour used as catalyst. When coming to preparation method, Shurkiua is prepared in a similar way to cheka and Madhota (pulla) is prepared in similar way to Errorota (Erera).

Cheka & Shurkuta preparation methods involve three major phases that are marked by cooking.

In first phase, grain flour is thoroughly kneaded with water in gebete and allowed to ferment for 2 up to 3 days for home consumption and occasionally for sale. This fermenting material is commonly referred to as pulota [7].

In the second phase, the fermented product (pulota) is kneaded with little or no water and then made into dough balls called qabot (Dammapulota). The dough balls shouldn't be less or much moistened. If the balls are less moistened, they become uncooked at the center and if too moistened they are too tiresome for kneading. During cooking, pieces of dried hop wood or peeled barks of some plants are placed at the bottom of the pot or barrel and excess water is added to prevent the dough balls from burning. If a lot of balls are prepared, most brewers add the dough balls thrice at an interval of 10 up to 15 minutes. The balls are added when the water is boiled (93 up to 95.5°C) and the barrel or pot is covered with a lid or a gourd that fits the pot. The dough balls are cooked for about 45 minutes to 1½ hours depending on the amount of balls and intensity of the fire. Cooking of the dough balls in water would be expected to gelatinize cereal starch granules and thereby increase the efficiency of starch degradation by amylase. The process of gelatinization occurs over a temperature range depending on the type and size of granules and starch to water ratio. Leaching of amylose occurs during gelatinization and thus creates available carbohydrate for the proliferation of fermentation microorganisms. Brewers often insert stick into the balls to check whether they are cooked well or not. When the dough balls are cooked well producers take one ball at a time and dip their hands quickly into water in a container handled by the other hand to avoid damage to them. Then, the dammaqabot is smashed in gebete using a beer bottle or a round-headed (pestle-like) material made from wood called tomambayta. Once the dough balls are broken down into pieces, they are kneaded with little water and spread on a plastic sheet, large sized gebete or a bed made from wood to cool for few minutes to 7 hours. However, the time of cooling not only depends on the amount of the product, but also the thickness of the product spread on the plastic sheet or gebete. After cooling, it is mixed with adequate milled malt, thoroughly kneaded and allowed to ferment overnight in a gebete (tommachaka). Cheka brewers spread a handful of malt on the surface of the kneaded product. The proportion of malt added during this phase can be as high as 25 % of the un-malted ingredient. Next day early in the morning, the product is transferred into large fermentation vessel (barrel or rotto); water is added and is then well mixed together. This actively fermenting material is commonly referred to as sokateta (Chaka Kordda). Sokateta can be stored for more than a week and so brewers may utilize a portion of it for preparing Cheka for home consumption. Some consumers would like to use this product and it is usually given to respectable people such as hard workers and close relatives [7].

In the third phase**,** on the same day the Sokateta is transferred into large containers and mixed with water, a very thick porridge (koldhomata or xanchalta) is prepared by pouring boiling water (97.5 up to 99°C) on to flour in gebete and thorough mixing using a material made from wood for this purpose or a flat stirrer (shanshita or ponqayta). The porridge is allowed to cool to room temperature for 5 up to7 hours and malt is mixed with the cooled porridge. The respondents indicated that the amount of malt added at this stage depends on the strength of the sokateta and amount of Cheka being produced. If the sokateta tastes much bitter, small quantity of malt is added or otherwise it would increase and this final product called Cheka [7].

3. Materials and Experiments

3.1. Sample Preparation

All the necessary ingredients like maize, sorghum and malt were collected from Konso Karat town. The method of preparation was obtained from women, who have long experiences in preparing Cheka as means of income as well as house hold drink in Konso Karat town and the villages around karat town such as Orashale village of Jarso Kebele. After preparing Cheka according to the procedure obtained, different confirmatory tests such as alcohol**,** carbohydrate and protein tests, *pH* and specific gravity measurements were done in Chemistry Laboratory College of Natural Sciences of Arba Minch University. The quantitative values of alcohol % by v/v, was also determined using specific gravity method, while that of protein content was determined using CHNS elemental analyzer method. Cheka preparation in different places has a slight difference in the method of preparation and the ingredients used to prepare Cheka in different areas are also different, although the name given to all is Cheka.

As indicated above the different types of Cheka was

prepared according to the procedures that konso peoples use in Konso Karat town and the villages around karat town. Flours of maize, sorghum, wheat and maize malts were used as ingredients to prepare different types of Cheka. After having the flours of all of the above ingredients, equal quantity of white and red sorghum powder were mixed with white maize powder then water was added to the mixed powders. The mixture was allowed for two days to undergo fermentation, and additional powder was added to facilitate for cooking after one day. The facilitated mixture was then cooked after one day (the mixture was shaped in rolled form before cooking). After it was cooked kurkufa was formed, the rolled form is converted to powder form by grinding. The grinded kurkuffa was allowed for a few hours in open air for cooling. Then the cooled kurkuffa was mixed with malt which was one-fourth of the amount of kurkuffa and the malt was distributed to all part of powder. The mixture was stored in dish with addition of small amount of water and covered with aluminum foil. After one day the crude Cheka was diluted with water according to the interest of the drinker and Cheka as a final product was obtained.

3.2. Determination of pH, Protein Value and Alcoholic Content Parameters of Different Types of Cheka

The pH values of all the four types of Cheka were measured by dipping the electrode of a digital pH meter to each sample at different stages.

A sample was taken from each type of Cheka for quantitative analysis of protein. The protein content of each sample was determined directly by CHNS elemental analyzer. The amount of protein was then determined by multiplying the nitrogen content by a factor of 6.25 as indicated in different literature [14].

200 mL of dilute Cheka was measured by measuring cylinder and transferred into a 500 mL glass reagent bottle and then stained for 2 hour to sediment solid part of Cheka from liquid. The liquid part of Cheka was decanted slowly from the residue (atella or tatta) in to separate reagent bottle, then the decanted part was transferred immediately in to 500 mL distillation flask and four (4) pieces of boiling chips were added in to the flask. After that the contents were distilled for about 45 min until the distillation thermometer reads between 77°C up to 80°C and the distillate was collected in a 200 mL plastic reagent bottle called receiver. The distillate was then placed in room temperature until it cools to 20°C.

A clean and dry empty pycnometer was taken and weighed along with the stopper at 20°C and the weight was recorded as W. The pycnometer was filled with distillate Cheka sample to the brim and the topper was inserted gently. The distillate Cheka sample was Wiped that spills out using water absorbing filter paper and weighed (W_1) at 20°C. Next the distillate Cheka sample was removed and the pycnometer was washed with distilled water. The pycnometer was then filled with distilled water in the same manner as described above and weight (W_2) at 20°C. This procedure also repeated for another Cheka type called Errorota.

The specific gravity was then calculated at different stages of Cheka and Errorota by the following formula.

$$\text{Specific gravity} = \frac{W_1 - W}{W_2 - W} \quad (1)$$

4. Results and Discussions

Table 1. *Qualitative confirmatory tests of alcohol, protein and carbohydrate for Cheka, Erroreta, Shurkuta and Pulla.*

No.	Test solution	Chemical to be tested	Types of Cheka	Observation
1	Jones's reagent	Alcohol	Cheka	Disappearance of orange color
			Erroreta	Disappearance of orange color
			Shurkuta	Disappearance of orange color
			Pulla	Disappearance of orange color
2	Tollen's reagent	Alcohol	Cheka	Formation of silver mirror
			Erroreta	Formation of silver mirror
			Shurkuta	Formation of silver mirror
			Pulla	Formation of silver mirror
3	Iodine solution	Carbohydrate	Cheka	Appearance of deep blue color
			Erroreta	Appearance of deep blue color
			Shurkuta	Appearance of deep blue color
			Pulla	Appearance of deep blue color
4	Fehling solution	Carbohydrate	Cheka	Formation of yellow precipitate
			Erroreta	Formation of yellow precipitate
			Shurkuta	Formation of yellow precipitate
			Pulla	Formation of yellow precipitate
5	Ninhydrin solution	Protein	Cheka	Appearance of pink color
			Erroreta	Appearance of pink color
			Shurkuta	Appearance of pink color
			Pulla	Appearance of pink color
6	Biuret solution	Protein	Cheka	Formation of pink color
			Erroreta	Formation of pink color
			Shurkuta	Formation of pink color
			Pulla	Formation of pink color

Table 2. *Protein value of Cheka, Erroreta, Shurkuta and Pulla from CHNS Elemental Analyzer.*

No.	Sample type	N %	C %	H %	Total	Protein value in %
1.	Cheka	11.1259	42.4184	6.9766	60.5209	69.5366
2.	Errorota	10.9378	45.7530	7.2833	63.9740	68.36095
3.	Shurkuta	11.8924	0.00	0.00	11.8924	74.32735
4.	Pulla	11.9568	0.00	0.00	11.9568	74.69249

Table 3. *Specific gravity of Cheka at different stages.*

Weight Type	1st Stage	2nd Stage	3rd Stage	4th Stage	5th Stage
weight of Empty pycnometer (W)	39.84	39.84	46.64	43.32	39.84
weight of pycnometer with 50 mL distillate Cheka sample (W_1)	94.65	92.97	88.45	86.91	85.12
weight of pycnometer 50 mL distillate water (W_2)	95.05	93.95	89.72	89.71	89.72
Specific gravity (SP. Gravity)	0.9927	0.9818	0.9705	0.9502	0.9077

Table 4. *Specific gravity Errorota at different stages.*

Weight Type	1st Stage	2nd Stage	3rd Stage	4th Stage	5th Stage
Weight of empty pycnometer (W)	34.45	34.45	46.94	43.32	43.32
Weight of pycnometer with 50 mL distillate Erorrota sample (W_1)	88.63	88.46	97.45	96.67	95.94
Weight of pycnometer 50 mL distillate water (W_2)	88.94	88.94	98.11	98.24	98.24
Specific. gravity (SP. Gravity)	0.9943	0.9912	0.9871	0.9714	0.9581

Table 5. *Alcoholic content and other parameters of Cheka at 20°C.*

No.	Parameters	1st Stage	2nd Stage	3rd Stage	4th Stage	5th Stage
1	Specific gravity	0.9927	0.9818	0.9705	0.9502	0.9077
2	Alcohol content % v/v	5.09	14.02	24.42	39.71	61.36
3	Alcohol content % v/w	4.05	11.30	19.89	33.05	53.45
4	pH Value	5.24	5.07	5.04	4.86	4.13

Table 6. *Alcoholic content and other parameters of Errota at 20°C.*

No.	Parameters	1st Stage	2nd Stage	3rd Stage	4th Stage	5th Stage
1	Specific gravity	0.9943	0.9912	0.9871	0.9714	0.9581
2	Alcohol content % v/v	3.92	6.22	9.51	23.61	34.45
3	Alcohol content % v/w	3.12	4.96	7.61	19.22	28.43
4	pH Value	4.86	4.80	4.72	4.32	4.12

Table 7. *Alcoholic content and other parameters of Shurkuta at 20°C.*

No.	Parameters	1st Stage	2nd Stage	3rd Stage	4th Stage	5th Stage
1	Alcohol content % v/v	0.00	0.00	0.00	0.00	0.00
2	Alcohol content % v/w	0.00	0.00	0.00	0.00	0.00
3	pH Value	5.03	4.85	4.62	4.57	4.45

Table 8. *Alcoholic content and other parameters of Pulla at 20°C*

No.	Parameters	1st Stage	2nd Stage	3rd Stage	4th Stage	5th Stage
1	Alcohol content % v/v	0.00	0.00	0.00	0.00	0.00
2	Alcohol content % v/w	0.00	0.00	0.00	0.00	0.00
3	pH Value	4.72	4.53	4.50	4.36	4.13

The qualitative confirmatory tests for carbohydrate, protein and alcohol results have presented in table 1 Shows the presence of carbohydrate, protein and alcohol. Using test solutions positive results have obtained for all types of cheka. This indicates the richness of Cheka in carbohydrate, protein and alcohol. Therefore all types of cheka could be good sources carbohydrate, protein and alcohol. As it is indicated in the literature, a basic amino acid lysine that is found in maize and sorghum is the main source for carbohydrate and the fermentation of sugar is the source for alcohol (ethanol) present in Cheka [8].

As it was shown in the table 2, the quantity of protein was found to be higher in those types of Cheka prepared without malt (Shurkuta and Pulla) and this could be attributed to insignificant level of alcoholic content in Shurkuta and Pulla as compared to that of Cheka and Errorota because according to literatures, several proteins were found to dissolve in alcohols due to esterification reaction which in turn affects their quantity [15].

According to this study stage means interval of days or each experiment for the specific gravity measurements have done after three consecutive days interval. One specific gravity experimental measurement has done after three days later than the first experiment. As it is indicated in the table 3 and table 4, prolonged duration have caused the decrement in the specific gravity of both Cheka and Errorota from first up

to fifth stages. According to literatures, the lower the specific gravity the higher is the alcoholic content. Hence, alcoholic content has found to be increased with prolonged storage of Cheka and Errorota.

As it has depicted in the table 5, the alcoholic content of Cheka at the 1st stage only has alcoholic content within the range of the standard value of beer alcoholic content; while the alcoholic content of Cheka in rest stages have values that are beyond the standard values of beer alcoholic content. The increased level of alcoholic contents is due to enhanced fermentation attributed to the malt that was used as a catalyst [13]. Consuming Cheka with an alcoholic content beyond the standard can pose different health problems such as gastritis, hypertension and mental problems. Apart from the alcoholic content, pH of each sample at different stages have also determined and found to be decreased from the 1st stage up to the 5th stage. This shows the continual increment in acidity due to excessive production of acetic acid with the prolonged duration of storage [13]. This can also increase the risk of gastrointestinal disorder. Therefore, with the prolonged duration of storage it is a risk that outweighs the benefit; hence consuming Cheka in its fresh stage is advisable.

Alcoholic content of Errorota has determined in table 6, using the same procedure as Cheka. Like that of Cheka, the ethanol content was increased from 1st stage up to the 5th stage. Except in 1st stage, the alcoholic content of Errorota in all stages is high. The alcoholic content is above the standard alcoholic content of beer. Again there is decrement in pH values; acidity has increased with prolonged storage. Therefore, consuming Errorota that was stored for a prolonged time can pose the same health threat as Cheka and hence the same advice is of a greater paramount. Errorota is more acidic than Cheka.

Finally, the specific gravity of Shurkuta and Pulla have not determined because of the negligible alcoholic content (table 7 and table 8). Except for the determination of pH and protein values, the procedures are not used for Shurkuta and Pulla, because of their negligible alcoholic content. Although it seems alcohol free, prolonged duration can, however, pose health problems due to the increased acidity as shown by decrement in pH values on their prolonged storage.

5. Conclusion

In conclusion, different tests for the characterization of biomolecules of Cheka confirm the presence of carbohydrates, proteins and alcohols in different type of Cheka. Despite the quality analysis quantitative tests were also conducted for level of proteins, specific gravity, alcoholic contents and PH values. According to the result obtained the level of proteins is higher in Shurkuta and Pulla as compared that of Cheka and Errorota. Specific gravity decreases with an increased duration of storage for Cheka and Errorota and found to be insignificant for both Shurkuta and Pulla. The results of this study have also showed that alcoholic content of both Cheka and Errorota increases with prolonged duration of storage, whereas the acidity of all types of Cheka was found to be increased.

An increment of alcoholic content in Cheka and Errorota and the raised level of acidity in all types of Cheka were associated with some health problems as in indicated in the literatures. Therefore, we strongly believe that the desired nutritional benefit could only be achieved when the food is consumed as fresh as possible. As we have seen, Cheka has different uses like energizing effect on the users, building up of their body, making of them being initiative and makes them good worker. But, with the prolonged duration both alcoholic content and acidity was found to be increased and in spite of all of the above advantages, it can affect the health status of the consumers if not ingested at its fresh stage. Therefore, it is highly recommended that; consumers should use fresh Cheka if they are to be benefited; people with gastric disorder and hypertension should restrict themselves from consuming either Cheka or Errorota because it can exacerbate their health problems; alcohol is metabolized by liver enzymes and hence Cheka and Errorota with high alcoholic content can cause hepatotoxicity. Therefore, people with hepatic problems should also be restricted from consuming them; and awareness should be created about all these facts so that all the consuming community will be highly benefited from such beverages with minimum risks.

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