Flavored Whey Drinks: Preparation and Evaluation of Selected Parameters

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Abstract
The aim of our work was the preparation of fermented flavored whey beverages using whey, probiotic cultures and suitable flavors. Whey fermentation by lactic acid bacteria appears to be an interesting alternative to improve the properties of whey and thus to offer its exceptional nutritional value, not only because of whey protein contained, but also due to the valuable products produced by microorganisms. Pasteurized whey was enriched by the addition of sheep culture ZS-25, which was isolated from sheep cheese and contains more varieties of species *Lactococcus lactis*, and also by the probiotic culture containing the microorganisms of *Bifidobacterium sp.*, *Lactobacillus acidophilus*, *Streptococcus thermophilus*. We focused our attention to select the appropriate type and concentration of flavor as well. Sensory evaluation was performed by the committee consisting of five intentionally selected professionally qualified persons. Taste of fermented whey drink was main observed property. Assessment of prepared whey drinks was repeated four times, each group consisted of 5 samples according to the following structure: sample A - whey drink with culture without flavoring, sample B - whey drink with culture and exotic flavor, sample C - whey drink with the culture and flavor of cranberry-grape-strawberry, sample D - whey drink with the culture and peach-orange flavor, sample E - whey drink with the culture and strawberry flavor. Flavored fermented whey beverages were sensorially evaluated. The order of individual samples determined by the evaluators was statistically processed by the Friedman test. Table value for this test for five evaluators and 5 samples is 8.99. The calculated values for all four sensory evaluations we performed, were higher than 8.99, so we rejected the null hypothesis and proved that among the different flavored whey drinks it is statistically significant difference. Overall, the worst evaluated was whey drink without flavoring. As the best accepted was strawberry flavor, it does not matter whether it was used sheep or cow whey, or sheep culture, ZS-25 or probiotic. We can conclude that strawberry flavor is the most appropriate to cover undesirable taste of whey.

Keywords: whey, flavor, sensory evaluation

1. Introduction

Whey is the liquid milk product obtained as a by-product of the manufacture of cheese, casein or similar products after coagulation of milk or milk products. The coagulation is performed mainly by the action of enzymes. When flavored whey products contain at least 51.0 percent of whey, they can be labeled as whey beverages [1].

The composition of whey varies considerably, depending on the composition of the milk, but the production process conditions used are also important [2].

Whey contains potentially valuable and useful components in the form of proteins, lactose, vitamins and minerals, but their state is diluted as the most represented part of the whey is water [3].

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For the production of whey beverages, it is possible to use different types of whey from the different kinds of cheeses. After cutting the cheese, whey is the most suitable in terms of quality. If it is not cooled to 6 ° C, its use is limited and requires careful monitoring and processing technology as soon as possible [4].

Soft whey beverages are made as a wide range of products obtained by mixing fresh, diluted or acid whey with various flavours, such as tropical fruit (but other fruits like apple, pear, strawberry and blueberry), crops and products (mainly bran), or chocolate, cocoa, vanilla [5].

Due to the presence of lactoferrin whey beverages can be used as functional food for improving the absorption of iron from food, and to protect the intestinal mucosa against pathogens. They also help to improve the absorption of calcium, which is important especially in the older part of the population that mostly suffers from osteoporosis. [6].

Whey drink with long success is the Swiss product, which uses a highly modified whey containing by 33%, the remaining 67% is the addition of water [7].

The taste of whey is often governed by starter cultures. According to the composition of the culture is resulting different taste and aroma. This allows producing whey beverages with similar sensory profile as fermented milk have. For the yoghurt flavor is characterized the presence of acetaldehyde, diacetyl, ethanol, 2-butanone and acetone [8].

Whey can have excellent functional and nutritional properties, but the taste may be sour and bitter. The acidity of the drink is treated with citric acid in particular. Sweet taste is increased with the addition of fructose, enzymatically hydrolysed lactose or sucrose. The content of carbohydrates in the beverages may be 5-6%, but even 11% and more. The pH of the whey beverages depends on the presence of other components [9] and ranges between 3 and 5 [8].

The differences in taste can be caused for example by using of different quality milk for cheese production, type of cheese, the treatment of whey from cheese after separation and the time from drying to pasteurization [8].

Experiments have shown that the best evaluated flavor is whey from the production of Cheddar and Gouda. Whey from the production of cottage cheese or mozzarella was less suitable [1].

The most typical approach for developing whey drink is mixture with fruit juices, especially citrus fruits, which are the friendliest with the flavor of whey. This is particularly in case of acid whey that is more appropriate for its application due to the high content of lactic acid and calcium compared to sweet whey. The fruit flavors used in commercial whey beverages include mango, grapefruit, lemon, orange, pear, or a combination [7].

Fermentation by lactic acid bacteria is one of the oldest methods of food processing and their preservation [10].

The fermentation of the whey by different types or strains of lactic acid bacteria may lead to a significant improvement of the beverage production, because of the symbiotic interaction among microorganisms. There are many combinations of microorganisms that can give necessary criteria for making beverages, such as low production cost, functionality and storage stability [11].

Our aim was to prepare flavored fermented whey beverage using whey, sheep and probiotic culture, and suitable flavor.

2. Materials and methods

Production of whey beverages using sheep culture ZS-25 and with probiotic culture

Sheep culture ZS-25

It is a culture isolated from sheep cheese and contains more varieties of the species *Lactococcus lactis*. It is usually applied in lyophilized form. It is used for the production of drinks, steamed cheeses, sheep's and cow's lump cheese.

Probiotic culture

It contains probiotic microorganisms *Bifidobacterium sp., Lactobacillus acidophilus, Streptococcus thermophilus.* It is used for the production of acid drinks.

Chemical analysis

Sterilization of devices was performed at 135 °C for 15 minutes.

Addition of cultures

Sheep culture in lyophilized form was dissolved in a small amount of milk at a temperature of 25-30 °C before vaccination. It was heat up (200 ml of whey) to 28 °C and the sheep culture was dissolved, then we added it to the remaining content of the whey, to ferment it. At the probiotic

culture whey were heated up to 38 °C to be dissolved.

Cultivation

Whey inoculated with the sheep culture was put in an oven which was preheated to temperature of 28 °C. The cultivation temperature is suggested to be 23-30 °C, we performed it at 28 °C and the duration was 20 hours. Whey inoculated with a probiotic culture was put into pre-heated thermostat at 37 °C, at this temperature the cultivation was performed, for 20 hours.

Cooling

The beverage was stored for 12 hours in the refrigerator in order to achieve optimal consistency and flavor.

Flavouring whey

The final step in the preparation of fermented whey beverages was the flavoring. Four different flavors (Table 1) were used.

Table 1. The amount of flavours added

		flavor	dose of flavor (%)	whey ml	flavor ml
cow whey	sheep culture ZS - 25	zero	-	200	-
		exotic	3	200	6
		cranberry	2.5	200	6
		peach	2	200	4
		strawberry	2	200	4
	probiotic culture	zero	-	100	-
		exotic	3	100	4
		cranberry	2.5	100	2.5
		peach	2	100	2
		strawberry	2	100	2
sheep whey	sheep culture ZS - 25	zero	-	200	-
		exotic	3	200	6
		cranberry	2.5	200	6
		peach	2	200	4
		strawberry	2	200	4
	probiotic culture	zero	-	100	-
		exotic	3	100	4
		cranberry	2.5	100	2.5
		peach	2	100	2
		strawberry	2	100	2

Sensorial analysis

Sensorial evaluation was performed by the committee consisting of five intentionally selected professionally qualified persons. Since our aim was the selection of suitable flavorings, the taste of fermented whey drink prepared was evaluated.

20 samples of prepared whey drinks were evaluated. 10 samples were prepared from cow whey, of which 5 samples were with probiotic culture (4 samples were flavoured and one was unflavoured) and 5 samples were with sheep culture ZS-25 and flavored (4 samples) and one sample was unflavoured. The same procedure was done in the preparation of further 10 samples from sheep whey, with the same cultures, and flavoring agents.

Individual samples were arranged in order by the best to the worst taste, following the protocol:

1- excellent taste (refreshing, delicious, characteristic for the product)

2- very good (pleasant)

3- good taste,

4 less good taste (taste dull for a given material)

5- unsatisfactory (unpleasant, nasty, bad).

Assessment of prepared whey drinks was repeated 4 x separately, each group consisted of 5 samples according to the following structure:

sample A - whey drink with culture without flavoring,

sample B - whey drink with culture and exotic flavor,

sample C - whey drink with the culture and flavor of cranberry,

sample D - whey drink with the culture and peach-orange flavor,

sample E - whey drink with the culture and strawberry flavor.

Statistical analysis

Results corresponding to the achieved order of individual samples were counted and processed statistically by the Friedman test. Table value for the Friedman test for five evaluators and 5 samples is 8.99.

3. Results and discussion

Soft whey beverages have a wide range of products obtained by mixing fresh, diluted or acid whey with various flavours, such as tropical fruit (but other fruits like apple, pear, strawberry and blueberry), crops and their products (mainly bran), and chocolate, cocoa, vanilla [5].

Cow whey with sheep culture ZS-25

Sample A (fermented whey without flavorings) showed significantly the worst taste. Sample B

(whey drink sheep culture ZS-25 with an exotic flavor) was as the best evaluated, followed by sample E with strawberry flavor.

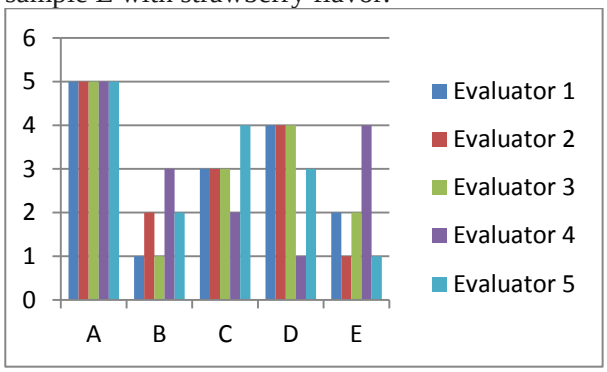

Figure 1. Results of the cow whey evaluation with sheep culture ZS-25

FR=[(12/n.P.(P+1)].[(R12+R22+R33+.....Rp2)] – 3.n.(P+1)
FR= [(12/5.5.(5+1)].[(252+92+152+162+102)] – 3.5.(5+1)
FR= 15.6
The calculated value was higher than 8.99, which is the value of the Friedman test for five evaluators and 5 samples. Thus, the null hypothesis is rejected, and the samples are significantly different.

Cow whey with probiotic culture

Sample A (whey drink with probiotic culture without added flavorings) manifested the worst taste, sample E (whey drink with a probiotic culture and strawberry flavor) was evaluated as the best.

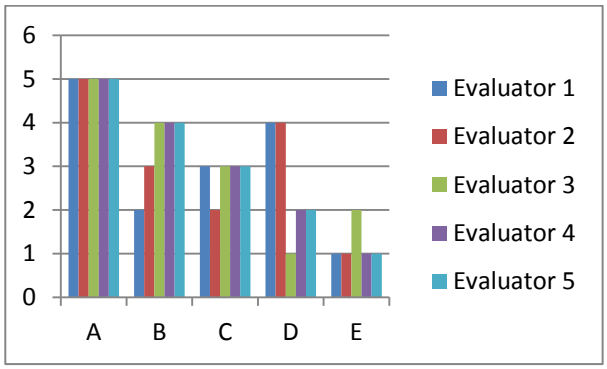

Figure 2. Results of the cow whey evaluation with probiotic culture

FR=[(12/n.P.(P+1)].[(R12+R22+R33+.....Rp2)] – 3.n.(P+1)
FR= [(12/5.5.(5+1)].[(252+172+142+132+62)] – 3.5.(5+1)
FR= 15.2

At evaluating of cow whey with added probiotic culture by the Friedman test, value was 15.2, which is higher than the tabulated value, therefore we confirmed that among the analyzed samples are demonstrable differences.

Sheep whey with sheep culture ZS-25

Results indicating the order of sheep whey enriched with sheep culture are summarized in Figure 3.

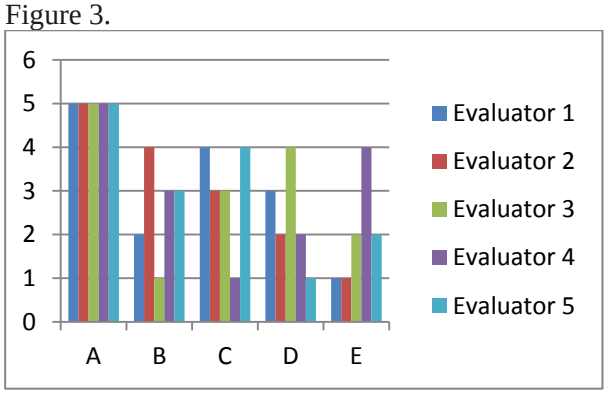

Figure 3. Results of the sheep whey evaluation with sheep culture ZS-25

FR=[(12/n.P.(P+1)].[(R12+R22+R32+.....Rp2)] – 3.n.(P+1)
FR= [(12/5.5.(5+1)].[(252+132+152+122+102)] – 3.5.(5+1)
FR= 11.04
The value 11.04 is higher than 8.99, so we rejected the null hypothesis. Sample A showed the worst taste again and sample E was assessed as the best flavor.

Sheep whey with probiotic culture

Again sample A (whey drink culture without flavorings) based on the results of sensory evaluation was the worst evaluated, contrary the best tasting showed sample E (whey drink with a probiotic culture and strawberry flavor).

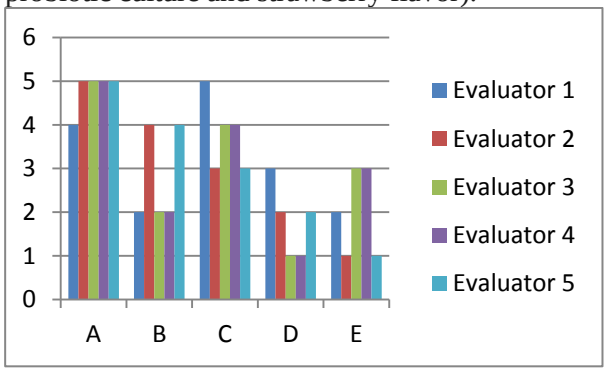

Figure 4. Results of the sheep whey evaluation with probiotic culture

FR= (12/n.P.(P+1)].[(R12+R22+R32+.....Rp2)] – 3.n.(P+1)
FR= [(12/5.5.(5+1)].[(252+142+192+92+102)] – 3.5.(5+1)
FR= 19,04

Jelen [7] referred fruit flavors, used in commercial whey drinks such as mango, grapefruit, lemon, orange, pear, or a combination.

By Suková [8] was proven the addition of peaches, while orange was not sufficient.

Campina company expanded in 2004 its offer on fruit whey drink "Optiwell" with 1% fat, no added sugar, as a currant and tropical flavor.

The German company Meggle launched whey drink in three flavor variants: orange and passion fruit, raspberry and lemon and apple [12].

For application in the food industry, in many cases it is needed to remove any salts present. Undesirable is very salty taste, but also functional properties and quality of products [13] can be affected.

4. Conclusions

Soft whey beverages have a wide range of products obtained by mixing fresh, diluted or acid whey with various flavours, such as tropical fruit (but other fruits like apple, pear, strawberry and blueberry), crops and products (mainly bran), and chocolate, cocoa, vanilla.

In all assessments statistical difference among the samples was confirmed, the worst sample with no flavoring and the best sample flavored with strawberries were observed. Exotic flavor, cranberry-grape-strawberry and drink flavored with peach-orange were not effective sufficiently to cover the original flavor whey. As the best accepted was strawberry flavor, it does not matter whether it was used sheep or cow whey, or sheep culture, ZS-25 or probiotic. We can conclude that strawberry flavor is the most appropriate to cover undesirable taste of whey.

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