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Application object-ice cream

1.1 Materials and methods

1.1.1 Test materials

Crystallized trehalose,Fresh milk(The raw material requires a fat content of 3.3% and a total solid content of 11.4%),Full-fat sweet milk powder(The raw material requires a fat content of 22.5% and a protein content of 19.3%), soft white sugar, xanthan gum, and konjac powder.

1.1.2 Test method

Formula design: Taking non-fat milk solid content 12%, fat content 6%-8%, sugar content 12% as basic indicators, a total of 7 formulas are designed as follows:

Recipe	1	2	3	4	5	6	7
Fresh milk	2409	2404.5	2406	2400	2394	2400	2394
Soft white sugar	360	310	260	210	160	110	60
Trehalose	0	50	100	150	200	250	300
Milk powder	231	231	231	231	231	231	240
Xanthan gum	0	4.5	0	0	0	4.5	0
Konjac flour	0	0	3.0	9.0	15.0	4.5	15.0

Table 1 Ice cream recipe table (unit: g)

Operation process:

ingredients-sterilization-homogenization-cooling-aging-freezing-finished product

Operating points:

① Ingredients: Proportion of different formulas according to Table 1: First heat the fresh milk bath to 50-60 ℃, add milk powder and mix thoroughly, slowly add the powdered sugar and stabilizer mixture powder while stirring, and use Fully mix with

electric mixer;

② Sterilization: When there is no solid precipitation or suspension, water bath heat sterilization: 75-76 ℃, 30min;

③Homogeneity: conditions 65 -70 ℃, 15-18MPa;

④Cooling: quickly cool the heated material liquid to 4-5°C with ice water;

⑤Aging: Aging at 2℃-4℃ for 24 hours;

⑥ Freezing: Measure the rheology and viscosity of the material before freezing.

Figure 1 Ice cream test sample

1.1.3

Comparison of freezing points of different sugar liquids

The freezing point of trehalose and soft white sugar was measured. The results are shown in Table 2. It can be seen from the table that when the ratio of trehalose and soft white sugar is 6:4, the ice cream made is better, and the uniformity is higher than that of white sugar. Ice cream is easier to shape than soft white sugar liquid.

Ratio	Freezing point/℃
Trehalose: soft white sugar (6:4)	-2.1—-1.8
Trehalose: white granulated sugar (0:10)	-3.2—-2.7

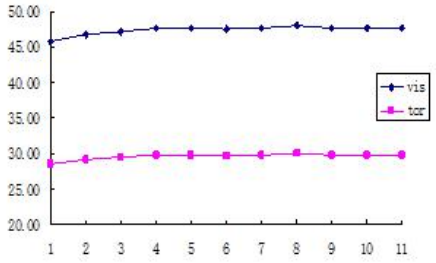
Table 2 Comparison of freezing points of experimental samples of soft ice cream

1.2 Result analysis

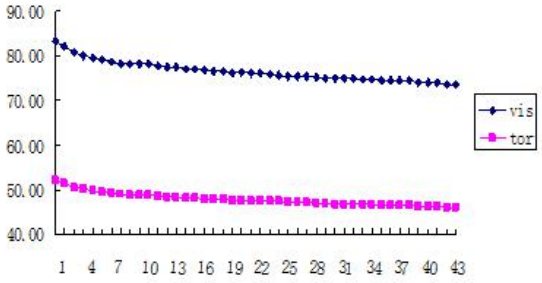
1.2.1 Research on the rheological properties of ice cream liquid

Figure 2 shows the change of the rheological indexes such as the shear force and viscosity of different ice cream ingredients over time. It can be seen from Figure 2-a and Figure 2-c that the shear force and viscosity of the material liquid with trehalose added There is a significant increase, indicating that the addition of trehalose can enhance the whipping performance of ice cream. After the trehalose and soft white sugar are compounded, it can be seen from Figure 2-f that the viscosity and shear force of the ice cream solution are not only further improved , And does not change with the extension of the whipping time.

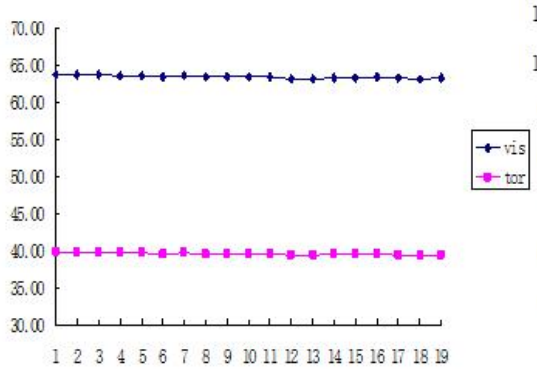
Further analysis of Figure 3, comparing the indicators of sample 1 and fresh milk samples, it can be seen that the addition of sugar and milk powder in the raw materials can increase the viscosity and shear force of the liquid, and the addition of trehalose after compounding will help On the basis of reducing the amount of stabilizer, the same viscosity and shear force (Formulation 4, Formulation 7) are achieved; the viscosity and shear force of the material liquid increase significantly with the increase of trehalose, and the material can be clearly found by sensory inspection. The liquid has silkiness, thick and sticky taste.



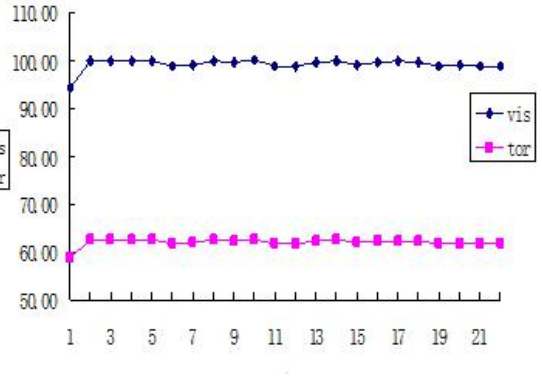
Recipe 1



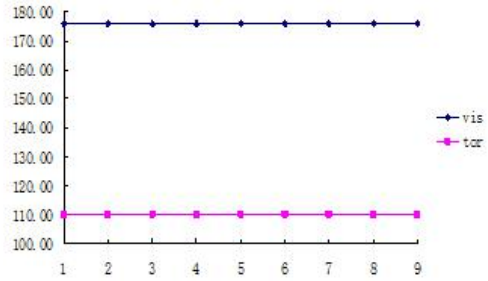
Recipe 2



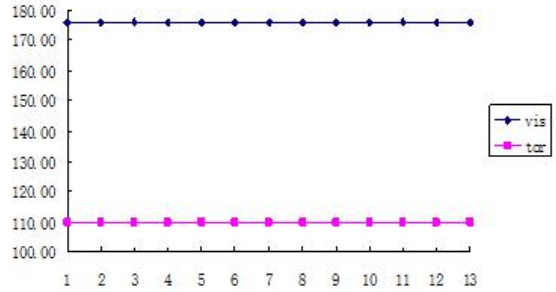
Recipe 3



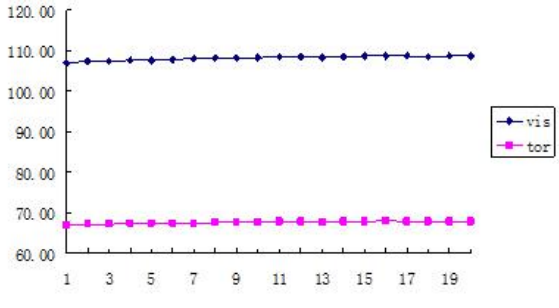
Recipe 4



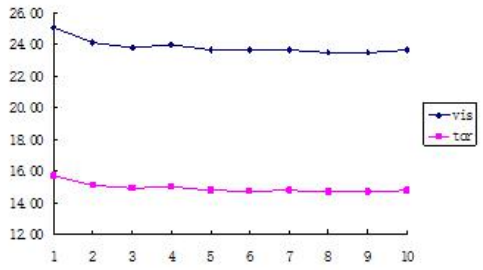
Recipe 5



Recipe 6



Recipe 7



Recipe 8(fresh milk)

Figure 2 The relationship between the viscosity and shear stress of the recipe ice cream ingredients with time

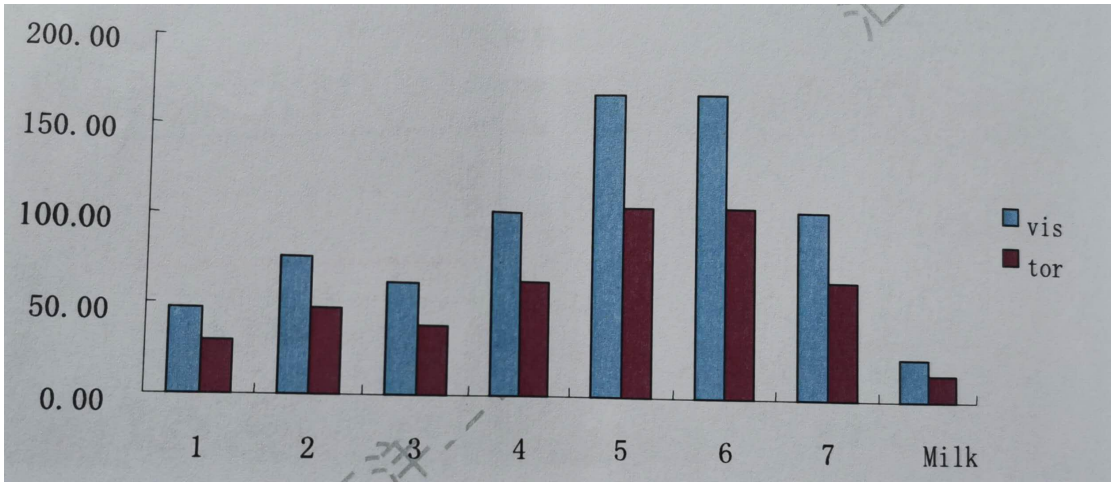


Figure 3 Comparison of viscosity and shear stress of different formulations

1.2.2 Quality assessment of finished ice cream

It can be seen from the analysis in Figure 5 that with the increase in the amount of trehalose added, the results show that it helps to improve the quality of ice cream. The ice cream made by adding trehalose has a fine and smooth taste, soft and refreshing, no ice crystal roughness, soft texture, and uniform structure. , Good standing and shape retention. Based on the analysis in Figure 4, the expansion rate of the hair product has a promoting effect and has an inhibitory effect on the melting rate.

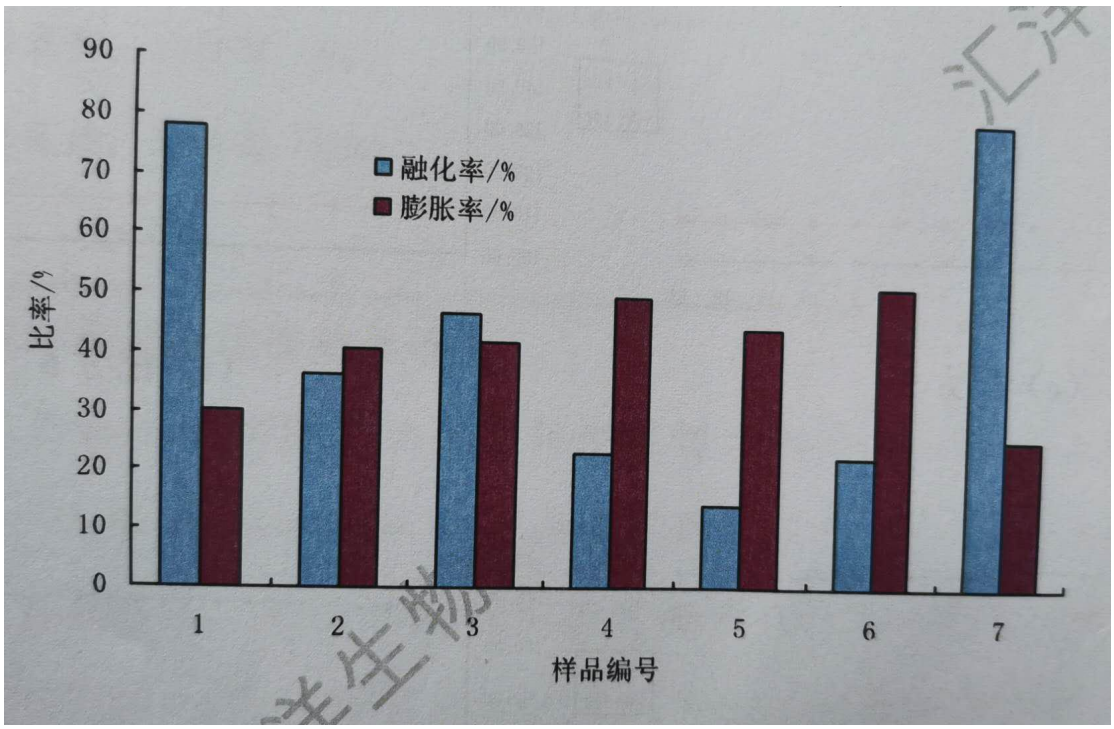


Figure 4 Comparison of expansion rate and melting rate of ice cream

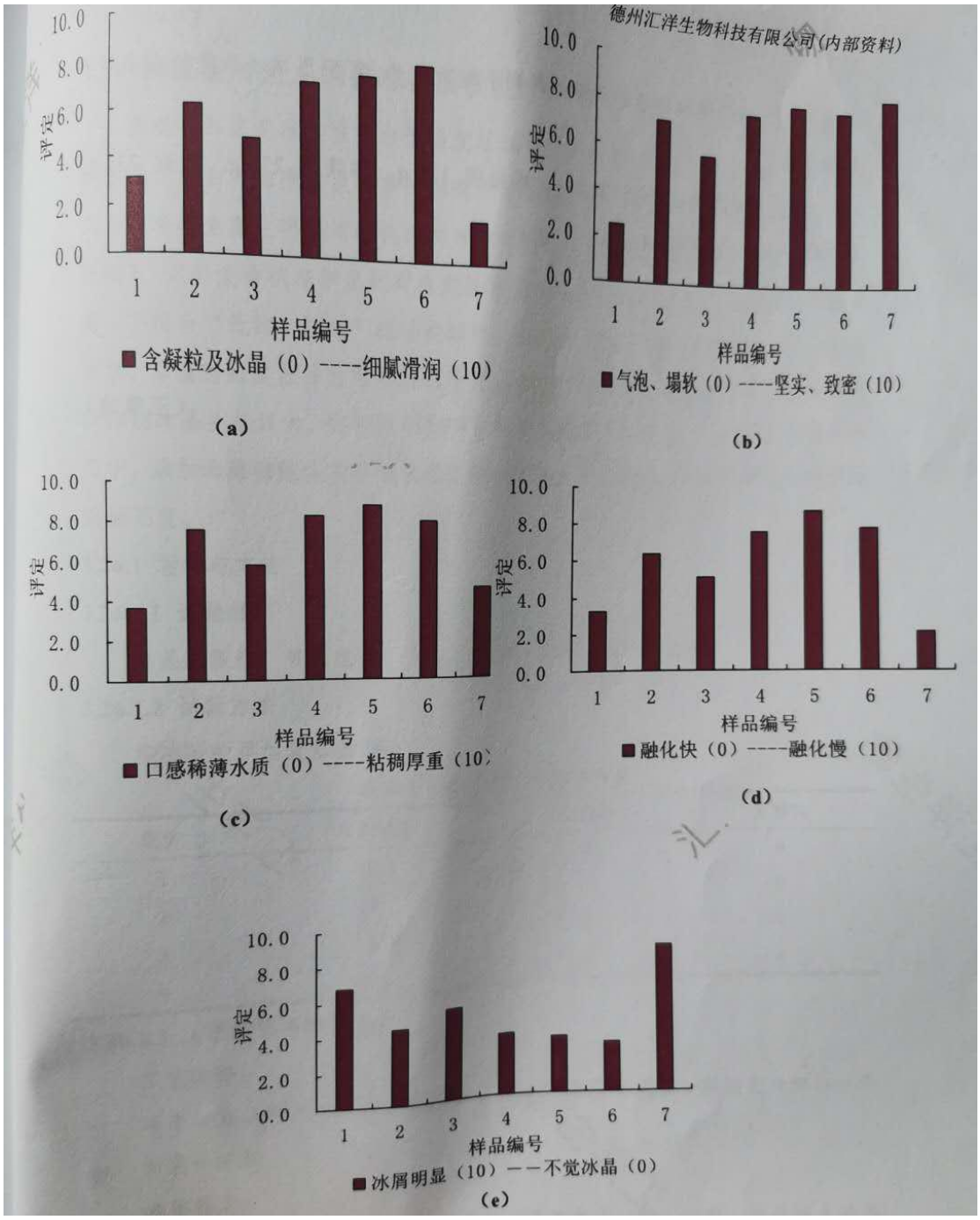


Figure 5 Sensory evaluation results of ice cream

1.3 Summary

1.3.1 The compound use of trehalose helps to enhance the viscosity and shearing force of the ice cream liquid. The appearance, texture and taste of the ice cream

after being made are effectively improved, which can significantly reduce the formation of ice crystals and inhibit the melting rate.

1.3.2 The best method

Fresh milk 2400g, soft white sugar 110g, trehalose 250g, milk powder 231g, xanthan gum 4.5g, konjac powder 4.5g。

. 应用对象—冰淇淋

1.1 材料与方法

1.1.1 试验材料

结晶海藻糖,鲜奶(原料要求脂肪含量 3.3%，总固体含量 11.4%)，全脂甜奶粉(原料要求脂肪含量 22.5%，蛋白质含量 19.3%)，绵白糖、黄原胶、魔芋粉。

1.1.2 试验方法

配方设计：以非脂乳固体含量 12%、脂肪含量 6%-8%、糖含量 12%为基础指标，共设计以下 7 种配方：

表 1 冰淇淋配方表（单位：g）

配方	1	2	3	4	5	6	7
鲜奶	2409	2404.5	2406	2400	2394	2400	2394
绵白糖	360	310	260	210	160	110	60
海藻糖	0	50	100	150	200	250	300
奶粉	231	231	231	231	231	231	240
黄原胶	0	4.5	0	0	0	4.5	0
魔芋粉	0	0	3.0	9.0	15.0	4.5	15.0

操作流程：配料-杀菌-均质-冷却-老化-凝冻-成品

操作要点：①配料：按表 1 进行不同配方的配比：首先将鲜奶水浴加热到 50-60 ℃，加入奶粉充分混匀后，边搅拌边缓慢加入糖粉与稳定剂的混合物粉末，并用电动搅拌器充分混匀；

②杀菌：当无固体沉淀或悬浮时，水浴加热杀菌：75-76 ℃，30min；

③均质：条件 65 -70 ℃，15-18MPa；

④冷却：将加热后的料液用冰水迅速冷却到 4-5℃；

⑤老化：在 2℃-4℃老化 24 h；

⑥凝冻：凝冻前测定流变性和料液粘度。

1.1.3 不同糖料液的冰点比较

对于海藻糖和绵白糖进行冰点测定，结果如表 **2** 所示，由表可知，海藻糖与绵白糖配比为 **6**：**4** 时制成的冰淇淋较好，均匀度高于白砂糖，因此制作的冰淇淋比绵白糖料液更易成型。

配比	冰点/℃
海藻糖：绵白糖（6：4）	-2.1—-1.8
海藻糖：白砂糖（0：10）	-3.2—-2.7

表 2 软冰淇淋实验样品的冰点比较

图 1 冰淇淋试验样品

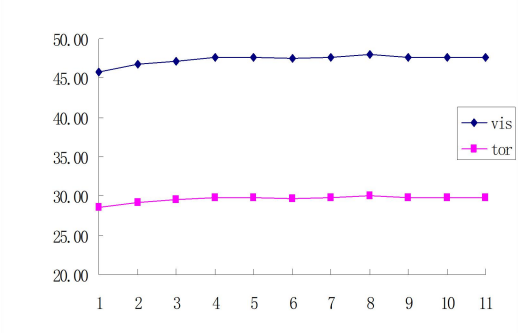
1.2 结果分析

1.2.1 冰淇淋料液的流变特性研究

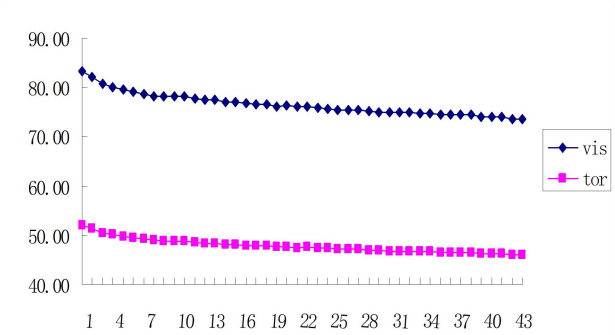
图 2 所示为不同配方冰淇淋料液剪切力和粘度等流变学指标随时间变化的情况，由图 2-a 和图图 2-c 可见，添加海藻糖的料液剪切力和粘度有明显升高现象，表明添加海藻糖可增强冰淇淋的搅打性能，将海藻糖和绵白

糖进行复配后，由图 2-f 可以看出，冰淇淋溶液的粘度和剪切力不仅进一步得到提高，而且不随搅打时间的延长而发生变化。

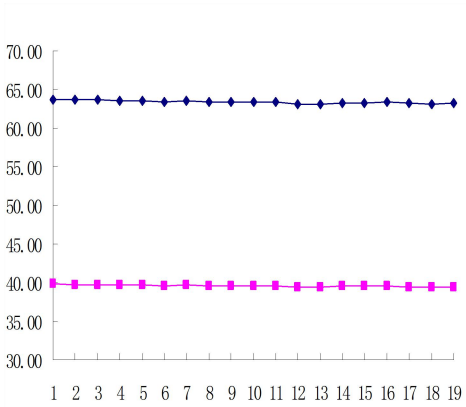
进一步对图 3 进行分析，对照样品 1 与鲜奶样品的各项指标，可以看出原料中糖和奶粉的添加可增加料液的粘度和剪切力，海藻糖复配后添加将有助于在减小稳定剂用量的基础上达到同样的粘度和剪切力（配方 4，配方 7）；料液的粘度和剪切力随着海藻糖的增多而明显提高，经感官检测可明显发现料液具有拉丝性，口感厚重粘稠。



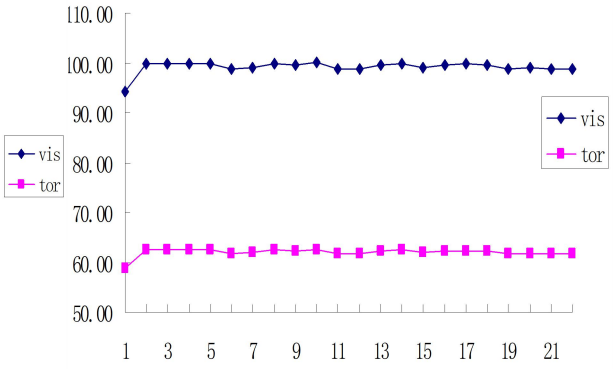
（a）配方 1



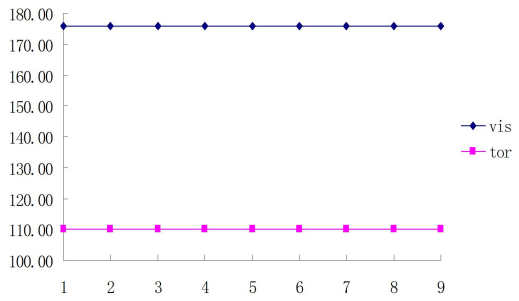
（b） 配方 2

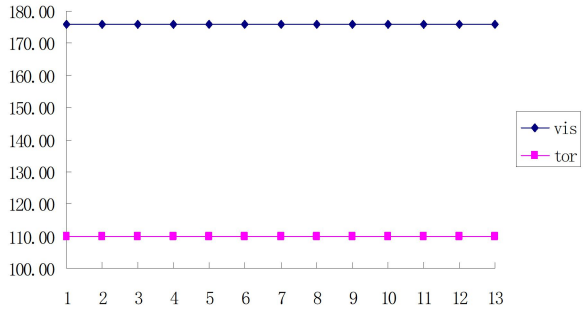


（c）配方 3



（d）配方 4





（e）配方 5　　（f）配方 6

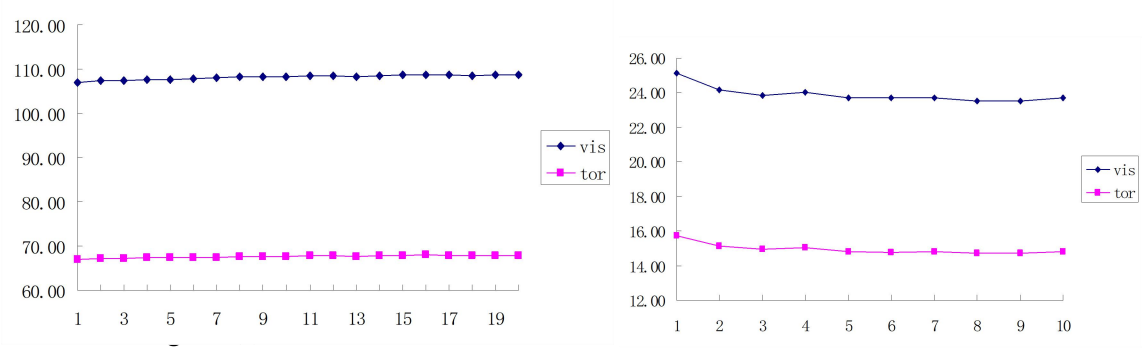


图 2 配方冰淇淋原料的黏度与剪切应力随时间变化关系

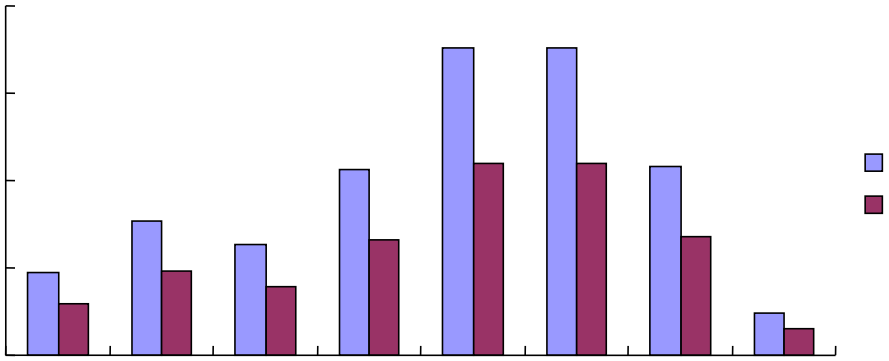


图 3 不同配方料液的黏度与剪切应力对比

1.2.2 冰淇淋成品的品质评定

由图5分析可知，随着海藻糖添加量的增加，结果显示其有助于改善冰淇淋的品质，添加海藻糖制得冰淇淋口感细腻润滑、绵软爽口、无冰晶粗糙感，质地松软，结构均匀一致，挺立度和保型性较好。结合图4分析，发品的的膨胀率有促进作用，对融化率有抑制作用。

图 4 冰淇淋的膨胀率和融化率对比

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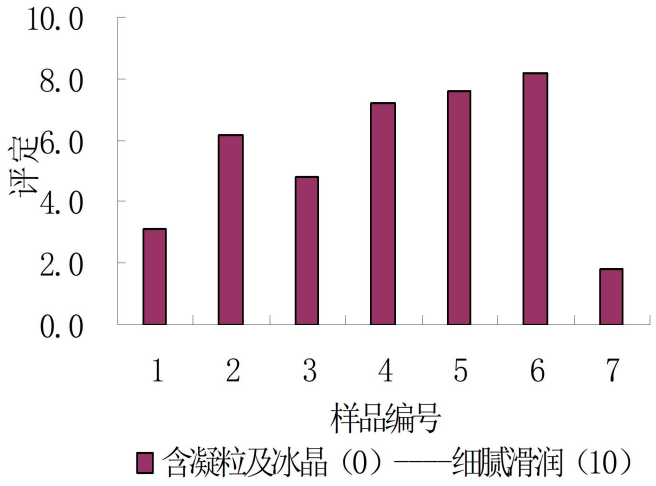
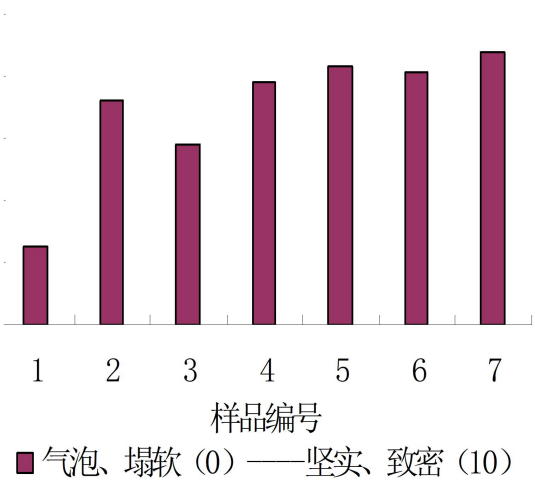


（a）



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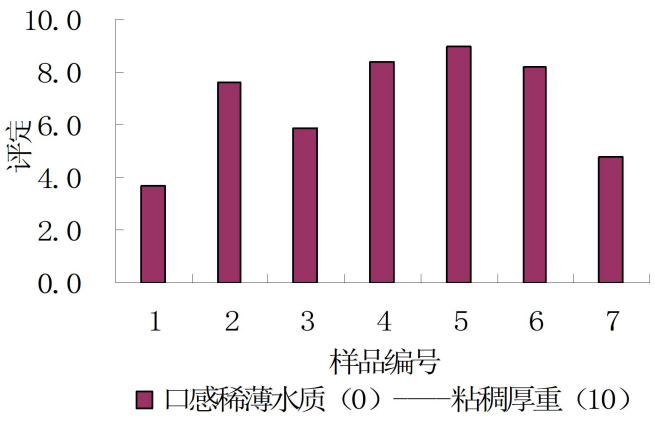

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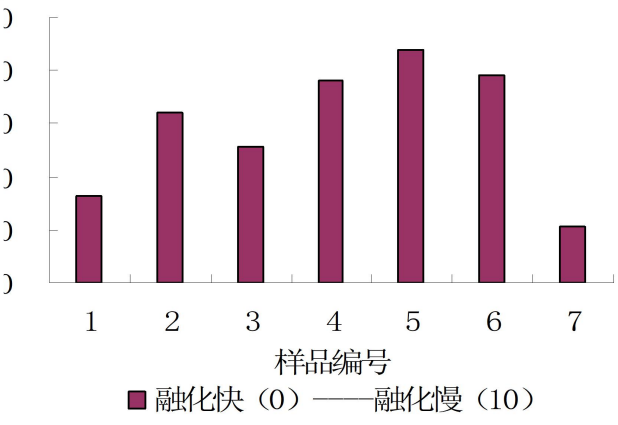

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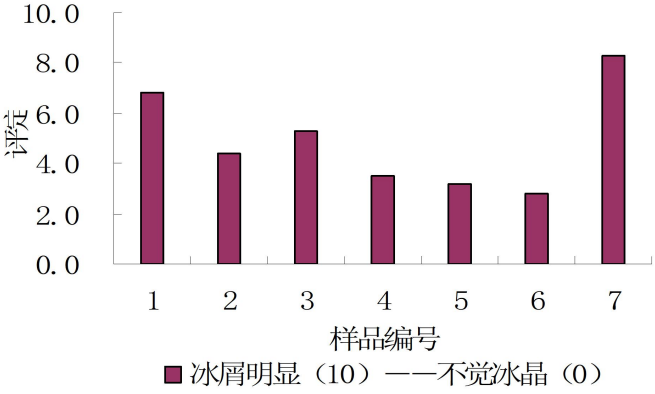

（e）

图 5 冰淇淋的感官评价结果

1.3 小结

海藻糖的复配使用有助于增强冰淇淋料液的粘度和剪切力，制作后的冰淇淋在外观质地和口感等方面均得到了有效改善，可明显减小冰晶的形成和抑制融化率。