TeRiFiQ

Project no. 289397

Combining Technologies to achieve significant binary Reductions in Sodium, Fat and Sugar content in everyday foods whilst optimizing their nutritional Quality

Start date of project: 1 January 2012
Duration of project: 4 years
Call: FP7-KBBE-2011-5
Theme: KBBE.2011.2.3-05 [Processed foods with a lower salt, fat and sugar content]
Funding Scheme: Collaborative Project (small or medium-scale focussed research project targeted to SMEs)

Deliverable D3.3

Bakery product nutritional quality, sensory performance and acceptance

Abstract: *Report describing the reduced fat/sugar product in comparison to commercial produced products in term of nutrition quality and consumer acceptance.*

Due date of deliverable: M48
Actual submission date: M49
Lead contractor/partner for this deliverable: MILLBA
WP3 Leader: WUR
Contributors: MILLBA, ADRIA

Dissemination level	
PU Public (must be available on the website)	X
PP Restricted to other programme participants (including the Commission Services)	
RE Restricted to a group specified by the consortium (including the Commission Services)	
CO Confidential, only for members of the consortium (including the Commission Services)	

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1. Section1 – Purpose

The target for WP3 "Bakery products with reduced fat and sugar content" was to reduce both fat and sugar content of bakery products by up to 25 % while keeping processing stability and fat functionality, sensory perception, texture properties and consumer acceptance of the products unchanged

We studied two types of bakery products in WP3. Muffins from Millba and Madeleines from Adria. Model products of muffins and madeleines, with nutritionally improved profile were developed.

The main objective of WP 3.3 was to upscale the nutritionally improved muffin to full production, evaluation of the nutritional quality, sensory performance and consumer acceptance.

The nutritionally improved muffin was subjected to Millba's standard quality control procedures to ensure nutritional quality and safety were not affected. Sensory analysis was carried out by Nofima. Preliminary consumer acceptance tests were carried out by Millba.

2. Section 2 –Results

2.1 Selected products

2.1.1 Muffins

Since none of the solutions for fat/sugar replacement that WUR worked with in WP3 was applicable as fat/sugar replacement in muffins, we decided to use inulin as fat/sugar replacement in order to achieve the reduction target for fat and sugar in the project, which was fat reduction by 25 % and sugar reduction by 25 %.

Millba's nutritionally improved muffin was baked with 25 % less rapeseed oil and 25 % less sugar compared to the reference product. The reduction was only compensated by adding inulin (Frutalose SFP) to the product.

Upscaling to full production pilot was executed in Millba's facilities. Millba's Milk Chocolate muffin was selected as reference, and we made Milk Chocolate muffin our upscaling model product. Milk Chocolate is Millba's biggest volume product, and a well known taste for consumers. This is a mostly American type of muffin baked with milk chocolate droplets inside and large milk chocolate chunks on top. Products are frozen online in production, and thawed before presented in store for consumers. Frozen shelf life is 12 months, thawed shelf life in room temperature is 28 days. Products are baked with preservatives and single wrapped.

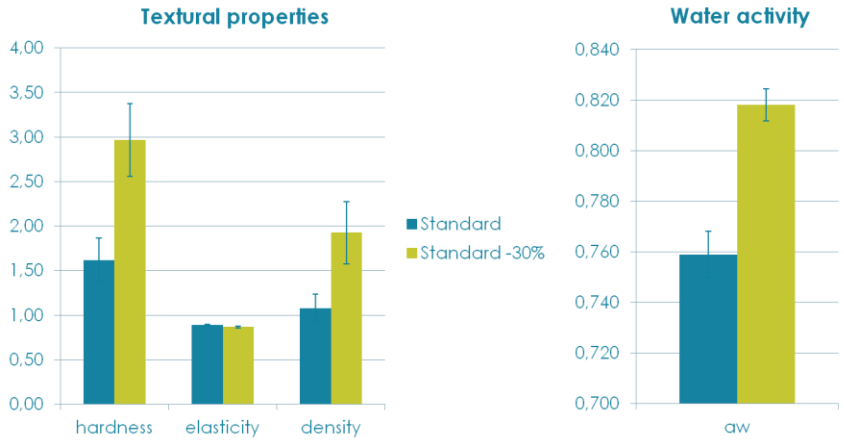
The only adjustment in production was done on baking time and temperature. Due to the inulin, the nutritionally improved muffin took quite fast a darker colour on the surface compared with the reference.

2.1.2 Madeleine

The Madeleine is a traditional sponge cake with a long shelf-life at room temperature. TeRiFiQ's aim is a binary reduction in fat and sugar content.

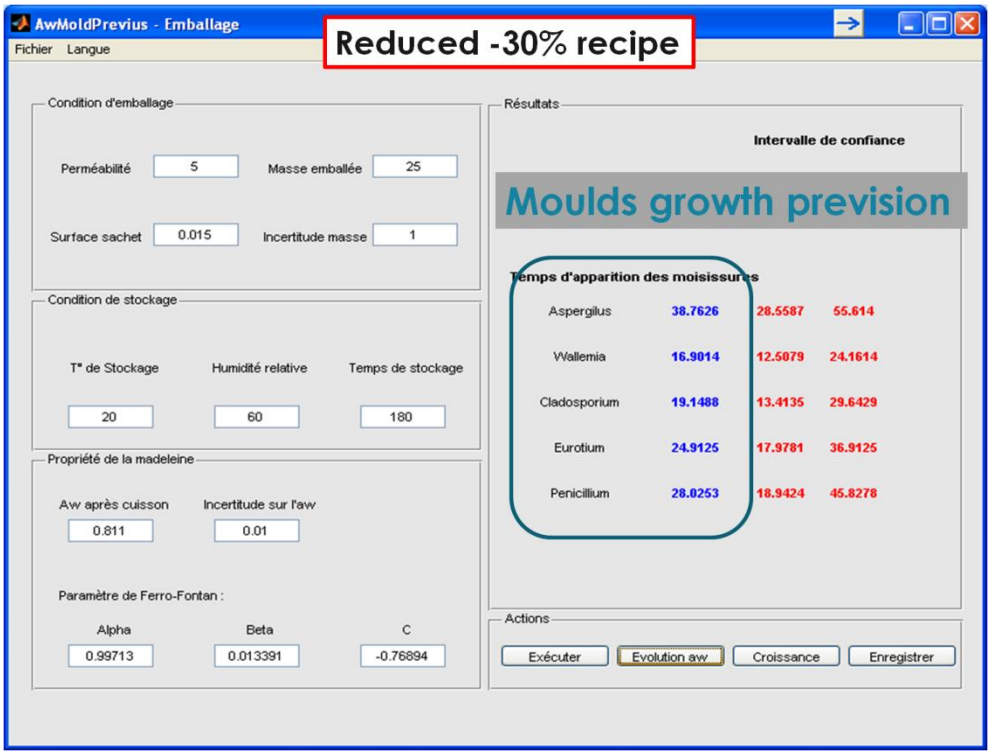
In Madeleine's recipe, fat matter used is rapeseed oil. The aim is then to reduce fat and not to improve fat profile, mainly composed of polyunsaturated fatty acids.

Reduction of fat and sugar without compensation leads to lack of coloration, poor rising, higher water activity which could increase risk of microbial spoilage.



The recipes were optimized using a water activity predictive software: AwDesigner. This parameter, as the temperature, is critical in the risk of molds apparition and growth.

ADRIA previously developed a predictive model of molds apparition time on egg cakes, which considers the storage time, the packaging, the temperature, and the water activity of the product. Using this model, ADRIA estimated the minimum shelf-life hoped to be observed for the reformulated products.



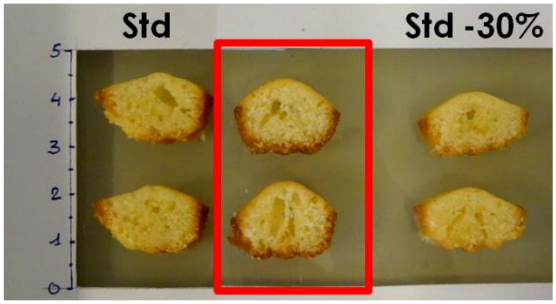
Various scenarii of sugar and fat substitutions were investigated.

For example, different kinds and rates of inulins and/or polydextrose were tested, and evaluated on different parameters, such as: Yield, dough and cake's textural properties, colour, specific volume, water content, and calculation of mold growth risk during shelf-life. Quite good results were obtained, but texture remains a bit firmer in mouth than with the standard, and increased water loss during storage.

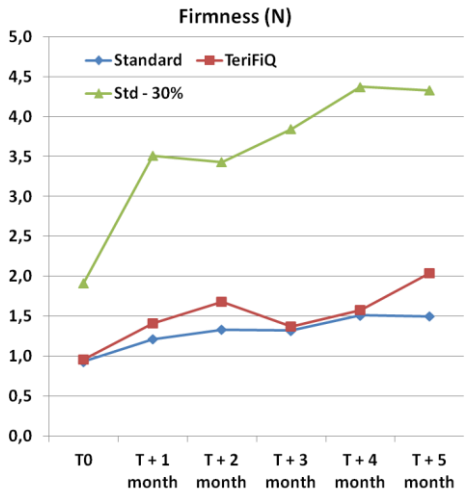
Based on exchanges with partners, we tried also waxy starch and multiple emulsions. We tend to improve the use of multiple emulsions with WUR (WP3 leader)'s help; even if it is not allowed by EC regulation yet (other partners did not make these trials).

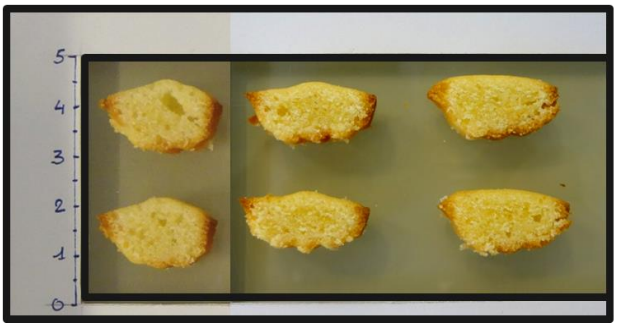
There again, yield, textural properties, colour, specific volume, hygroscopic and spoilage aspects were studied and compared to previous data. Good raising properties and improvement of textural properties during storage were observed using waxy starch.

But trials using multiple emulsions did not lead to success, particulary due to a lack of rising and aeration of the crumb. The heating of the dough during cooking certainly induced a destabilization of the double emulsions and then a release of the water enclosed in the multiple emulsion. Thus the viscosity of the dough was not sufficient enough to keep the gas bubbles inside during cooking.



TerifiQ with 1%of waxy rice starch





Standard WOW Low Fat butter

2.2 Nutritionally improved product compared with reference product

2.2.1 Muffins

2.2.1.1 Nutritional quality

Table 1. Nutritional values of reference muffin and nutritionally improved muffin

	Reference muffin	Nutritionally improved muffin
Total product (g)	100	100
Energy (kJ – kcal)	1589 kJ, 380 kcal	1443 kJ, 345 kcal
Total fat (g)	21.1	17.5
Saturated (g)	3.8	3.5
Carbohydrate (g)	41.7	43.5
Sugars (g)	24.7	21.3
Protein (g)	5.5	5.5
Salt (g)	0.9	1
Fibre (g)	3.0	7.4

The nutritional values did not improve as much as we had predicted.

Nutritional value of inulin pr. 100g:
Carbohydrate 97 g
- Digestible (sugars) 15 g
- Non-digestible (oligo fructose) 82 g

According to EU directive 2008/100/EC the caloric value of oligo-fructose is 2 Kcal / gram.

The inulin contributes with a significant amount of carbohydrate that needs to be declared. The nutritionally improved muffin contains an increased amount of carbohydrate, but less sugar. On the other side, the inulin more than doubles the amount of fiber compared with the reference.

In order to make a muffin with better nutritional profile, we could have used sugar free chocolate instead, but for the project we chose to use the same chocolate as in the reference. Sugar free chocolate taste different and would probably make a significant influence on the sensory tests.

2.2.1.2 Sensory performance

Nofima performed QDA (quality descriptive analysis). The sensory evaluation was carried out by a panel of 10 well-trained sensory assessors at Nofima AS, Norway. The panellists were selected and trained according to recommendations of ISO 8586:2012 General guidelines for the selection, training and monitoring of selected assessors and expert sensory assessors, and ISO 13299:2003 General Guidance for establishing a sensory profile. The aim was to investigate the sensory profile of five different muffins.

A list of 23 descriptive attributes for the muffins were agreed by the assessors and used in the study. Each muffin was divided into 4 equal sized parts before serving to the assessors on coded plates. The samples were analysed in duplicate at room temperature in a randomized order according to sample, replicate and assessor. For neutralization of the taste organ, the panellists were required to rinse the mouth with lukewarm water and unsalted crackers between samples. The panellist recorded their results at individual speed on a 15 cm non-structured continuous scale where the left side represented low intensity, and the right side high intensity. A computer transformed the responses into numbers between 1 (low intensity) and 9 (high intensity).

The test was conducted on five different muffin samples:

1. Plain Muffin, reference
2. Plain Muffin, 25 % reduction in sugar and fat + inulin
3. Plain Muffin, 25 % reduction in fat, with water replacement
4. Milk Chocolate Muffin, reference
5. Milk Chocolate Muffin, 25 % reduction in sugar and fat + inulin

There were no significant differences between the attributes for the samples baked as plain muffins (Fig.1). For the muffins with milk chocolate, small differences were found for juiciness, vanilla odour and sour flavour (Fig.2).

The Milk Chocolate reference muffin had a more intense sour flavour, a higher score for juiciness and less intense odour of vanilla than the new formulated product. However, the differences were considered so small that consumers probably would not detect the change in recipe.

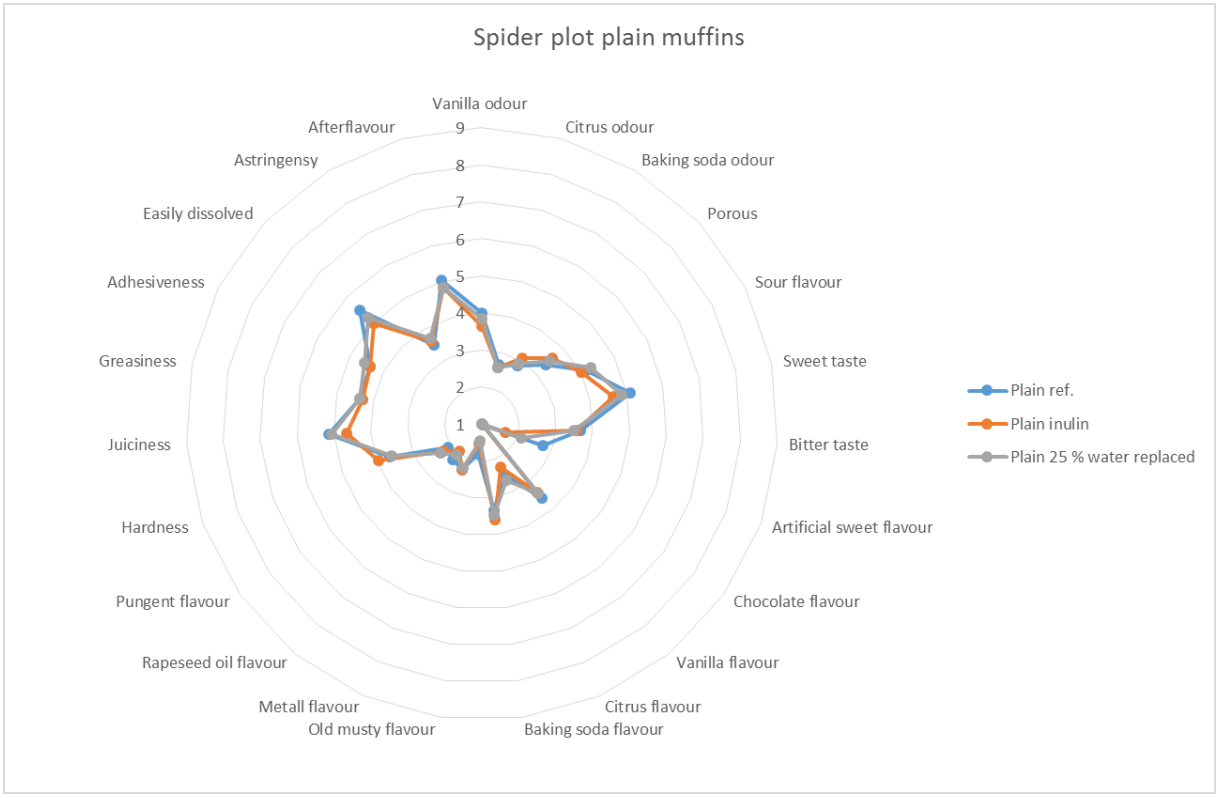


Fig. 1 Spider web diagram of sensory results for the plain muffins.

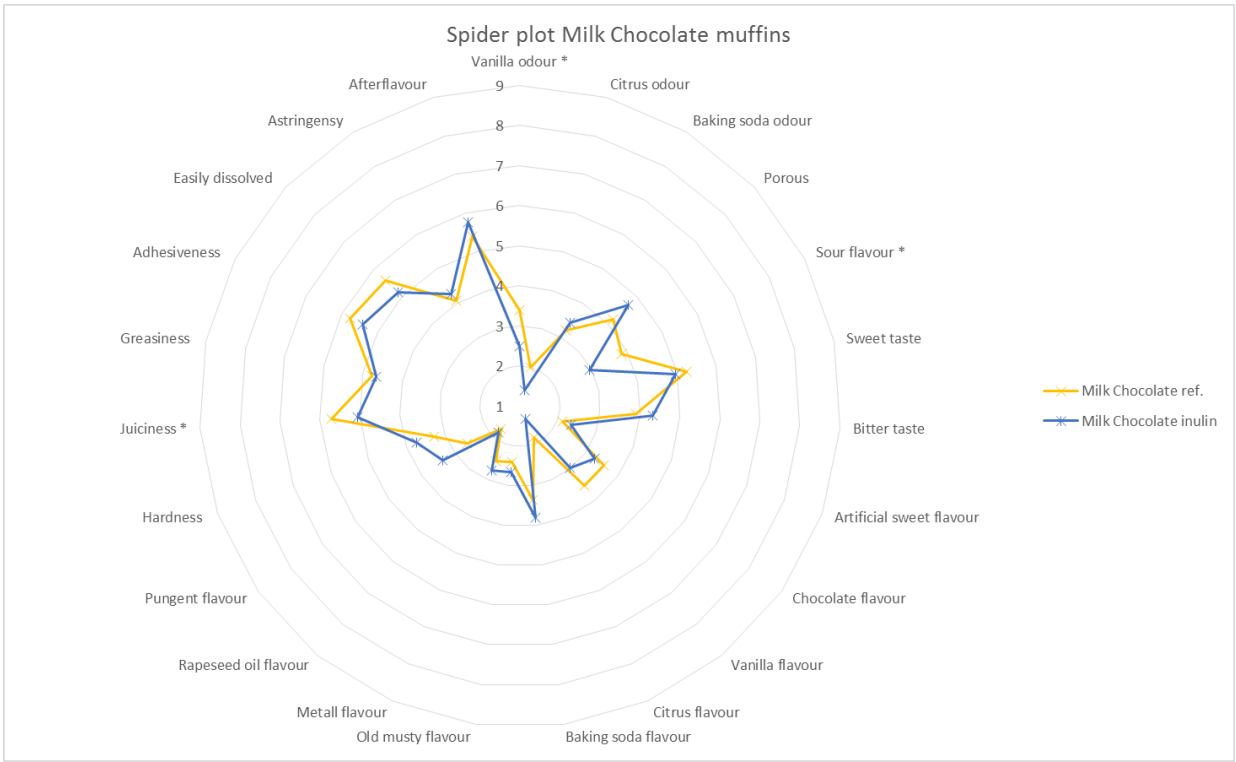


Fig. 2 Spider web diagram of sensory results for the Milk Chocolate muffins.

2.2.1.3 Consumer acceptance

Four triangle tests were conducted at Millba, Norway. Test of two samples: Reference muffin and the nutritionally improved muffins.

1. Reference muffin, 25 % reduction of sugar and 25 % reduction of fat + Frutalose SFP (Products had been thawed for 24 hours)

2. Reference muffin, 25 % reduction of sugar and 25 % reduction of fat + Frutalose SFP (Products had been thawed for 24 hours)

3. Reference muffin, 25 % reduction of sugar and 25 % reduction of fat (Products had been thawed for 24 hours)

4. Reference muffin, 25 % reduction of sugar and 25 % reduction of fat + Frutalose SFP (Products had been stored at room temperature for 28 days)

We used the same recipe for triangle test number 1 and number 2. For number 1 the products were baked in the test kitchen. For number 2, the products were baked in the production at large scale. We wanted to see if there were differences, but no difference was found. We got the same result on both tests.

We used an untrained panel consisting of 20 people for each triangle test. In total, 80 Norwegians tasted the products. They could not distinguish between the two products in any of the tests.

In WP 6.5 Sébastien Romagny, Emilie Ginon and Christian Salles from INRA did field and lab studies mixing sensory evaluation and experimental economy:

"Impact of reducing fat, salt and sugar in real food products on the consumer behavior"

The study was conducted in France, with French consumers. The consumers did their evaluation of liking, pricing and comparison with other brands. In this study Millba's nutritionally improved muffin successfully maintained consumer appreciation. Conclusion was that nutritionally improved product was at least as acceptable as the reference.

Neither the Norwegian nor the French could distinguish between the two products in any of the tests.

2.2.2 Madeleine

2.2.2.1 Nutritional quality

	Standard	TeRiFiQ's Madeleine
Energy (kJ – kcal)	1860 - 444	1665-395
Total fat (g)	22.6	17.1
Saturated (g)	2	1.6
Carbohydrate (g)	49.2	45.2
Sugars (g)	25.6	20
Protein (g)	7.1	7.3

Amount of nutrient in a product may vary due to factors such as source of values, variation in the raw materials, effect of processing, storage conditions and time. The values are within the tolerances around the declared values (EC guidance document, 2012).

2.2.2.2 Sensory performance

A multi products trained panel, 10 experts, has been conducted to identify the optimization trends. This study has been subcontracted.

The main difference is on the textural aspect. TeRiFiQ Madeleine (reduced one) is firmer than the Standard.

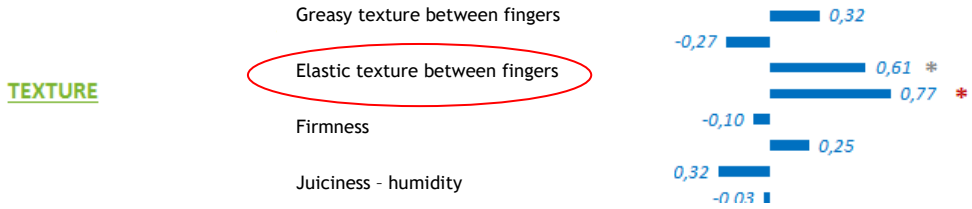


Figure 3. Comparative profile (10 experts).

In the mouth, the TerifQ madeleine is considered less dry than the Standard but tends to be firmer.

Experts also underline the enhancement of salted taste in TeRiFiQ Madeleine.

No significant differences were found on the fatness and sweetness feeling in mouth during degustation.

In order to improve texture corresponding to consumer requirement, optimizations in formulation have been conducted: pre-hydration of fibers, adjustment of the viscosity.

The shelf life of the reformulated product was studied during 6 months, assessing spoilage, hygroscopic and textural aspects for quality control.

Finally, we begin to investigate improvements of cross-modal interaction in the Madeleine product. Starting with 8 aroma, 4 were selected and tasted by a panel of 30 people.

2.2.2.3 Consumer acceptance

ADRIA follows acceptance of consumers through internal resources.

It has been conducted deeper in WP6 task.

3. Section 4 – Conclusions

At the starting point of TeRiFiQ project, cake industrials answered that reduction of sugar while maintaining consumers' acceptance was a quite difficult aim. Through this project, we succeeded to reduce both fat and sugar without impairing consumers' acceptance. This is particularly remarkable for long shelf-life products.

3.1 Muffins

To achieve the reduction, we used inulin as fat and sugar replacement. It turned out easier to reduce fat than sugar; the inulin was needed to maintain consumer acceptance.

Only small technical adjustments in production was needed, i.e. baking time and temperature to find the right colour of the product

Because of the regulatory status of ingredients and the technologies used, no restriction appears on the acceptability of the innovation.

Understanding of consumer acceptance has given us a tool that will be used in future developments at Millba.

3.2 Madeleines

Understanding interactions between structure and aroma release, odor-induced taste enhancement are applications that will be followed with interest in ADRIA Développement. Studies on multiple emulsions will be carried out in order to achieve an industrial and regulatory acceptable answer.

Technical adjustments in production are needed, i.e. baking time and temperature to find the right colour, texture and rising of the product.