RESEARCH REGARDING THE INFLUENCE OF THE FLOUR SORT ON THE TEXTURAL, PHYSICO-CHEMICAL AND SENSORY PARAMETERS OF SOURDOUGH BAKERY PRODUCTS

Otilia Cristina MURARIU[1], Petru Marian CÂRLESCU[1], Florin Daniel LIPȘA[1], Adnana Gabriela SANDU[1], Florin MURARIU[1], Carmen Daniela PETCU[2], Oana-Mărgărita GHIMPEȚEANU[2]

e-mail:ghimpe_marga@yahoo.com

Abstract

The structural, physico-chemical properties and sensory characteristics of sourdough bakery products represent important quality indicators that may be modified adue to changes in the process and parameters for products obtaining. The main role of sourdough used in the process of bakery products obtaining, consists on the fermentation process achievement, through the metabolism of sugars by the enzymatic action of sourdough and the release of CO_2, alcohols and other secondary products. Natural sourdough differs mainly from compressed yeast in that the fermentation process in natural sourdough involves a slow process, called lactic fermentation, described as an anaerobic process in which organic substances are transformed into lactic acid by the action of microorganisms, whereas compressed yeast enriched with yeasts of the *Saccharomyces cerevisiae* genus, involves a rapid process of alcoholic fermentation. The main purpose of the present research was to identify the influence of the flour sort on the quality of natural sourdough and on the textural, physico -chemical and sensory properties of the sourdough bakery products. Thus, two type of natural sourdough were obtained, respectively m_1 – with superior flour (000 type) and m_2 – with white flour (650 type) + wholemeal-flour (1350 type). The two types of sourdough were integrated into the recipes for the five experimental variants of bakery products, as follows: $m1_{650}$; $m1_{650,000}$; $m1_{000}$, $m1_{650,1350}$; $m1_{000,1350}$; $m2_{650}$; $m2_{650,000}$; $m2_{000}$, $m2_{650,1350}$ and $m2_{000,1350}$. The results of the research in terms of sensory evaluation are revealed that the variant $m1_{650,000}$ was the most appreciated for most characteristics.

Key words: sourdough bakery products; sensorial characters; porosity

The bakery products are considered to be the most traditional food consumed wordwide for centuries. The classic bread recipe consists mainly of cereal flour (wheat or rye), water, salt and the production of intermediate products (yeast), responsible for the release of CO_2 and, subsequently, for obtaining the final dough.

In general, three categories of leavening agents are used: chemical agents, baking agents (yeast) and sourdough. The first two types are marked and produced on an industrial scale, while the industrialization of yeast just beginning to take of. The implementation of methods for sourdough bread production at the moment presents an important trend in the production of bakery products, due to consumer demands for high-quality bread without chemical additives.

Natural sourdough differs mainly from compressed yeast used in industry domain, in that in the fermentation process. In the case of natural sourdough, a slow process takes place, called lactic fermentation, described as an anaerobic process through which organic substances are transformed into lactic acid under action of microorganisms.

Thus, the process of obtaining innovative prodducts based on the use of different types of yeast, which bring a qualitative contribution in terms of improving the sensory, physico-chemical and organoleptic properties (Murariu O.C., *et al*, 2022; Ghimpețeanu O.M. *et al*, 2016) of the finished product, is closely followed.

The data from literature refer to the importance brought by bakery products in satisfying certain food requirments expressed by different categories of consumers (Murariu O.C., *et al*, 2016; 2019 a,b; Petcu C.D. *et al*, 2007; 2019), while also developing the implementation of new manufacturing technologies, through which the automation is attemped technological processes and increasing the assoretment area by creating new products that ensure the improvement of organoleptic and physico-chemical properties in

[1] Iasi University of Life Sciences, Romania
[2] University of Agronomical Sciences and Veterinary Medicine of Bucharest, Romania

order to satisfy the demands expressed by consumers (Bordei M., 2005).

Among the most important advantages of making bakery sourdough products are: improving the spoiling process, resistence to possible contaminantion and molding, improving the nutritional and sensorial quality by developing a pleasant taste and smell of alcohol, respectively improving the texture.

The applicability of the sourdough bread production process is highlighted by responding to the current demanding of consumers and at the the same time, it responds to the new trend of the food industry represented by functional foods (Plessas S., 2021).

Sourdough is obtained from a mixture of fermeted fruits juice, flour and water, possible with small added of sugar and salt. The fermentation process took place spontaneous by lactic bacteria and yeasts that determine its acidifying properties and fermentation capacity. These activities are obtained and optimized through consecutive processes called "refreshers". The term of "refreshing" refers to the technique by which a dough made from flour and water which ferments spontaneously for a certain time (at a defined temperature) which is later added to a new mixture of raw materials to start fermentation.

When applied for a defined period of time, such a process produces a sourdough with constant and repeatable fermentation and acidification performance, which depends on the development of lactic bacteria and yeasts well adapted to the environment. After the preparation of the yeast dough, the refreshing technique aims to maintain the metabolic activity of the bacteria (Gobbetti M. *et al*, 2012).

Sourdough is an intermediate product in the preparation of dough and bread that contains metabolically active microorganisms (Murariu O.C. *et al*, 2021 Ghimpețeanu *et al*, 2017). Due to their artisanal and region-dependent handling, sourdoughs are a hyge source of various species and strains of lactic acid bacteria and yeasts. Cell densities exceeding 108 colony forming units (CFU/g) of dough are common in acid fermentations (De Vuyst L. *et al*, 2005)

In terms of directly increasing the degree of efficiency in obtaining bakery products, to reach the maximum potential from a qualitative point of view, researchers such as Tsegaye Z. *et al*, 2018, developed studies of uses of vareious species of yeasts isolated from local fruits (Ethiopia), used in industrial baking. The results showed that the yeast species *S. cerevisae, S. blourdeous, Z. fermentatii, C. sorboxylosa*, *C. apicola* and *I. orientalis* tolerated different temperature ranges up to 37°C and alcohol concentration up to 14%. The leavening capacity of the identified yeast species was examined by fermentation of the flour dough. The fermentation test was performed at room temperature, 30°C for 12 hours. The results indicate that the leavening power of the yeast species identified in local Ethiopian fruits is comparable or even than the ability of commercial yeast to leaven bread dough (Tsegaye Z. *et al, 2018)*. Following the test, it was demostrated that the leavening properties of the dough fermented with various yeast cultures isolated from local fruits: *Saccharomyces cerevisae, Saccharomyces blourdeous, Zygosaccharomyces fermentatii, Candida sorboxylosa, Zygosaccharomyces bisporus, Kluveromyces delphensis, Pichia holistii* and *Candida apicola* presented a suitable leavening capacity providing a specific dough volume of up to 220/ 210 cm/g, 220/191 cm/g, 189/ 193 cm/g, respectively 184/200 cm/g, at room temperature and at 30°C for 12 hours except for commercial yeast, with values of 180/182 cm/g.

The positive influence of sourdough making technology on bread mainly depends on the metabolic activities of lactic acid bacteria present in the fermentation medium (Hümeyra I. *et al*, 2020). Thus, the production of leaven has the primary purpose of multiplying yeast cells that determine the appropriate loosening of the dough and obtaining secondary fermentation products, representative being lactic acid (*Lactobacillus* species) (Shewry P.R. *et al*, 2022).

Also, the production of acetic acid, ethanol, aromatic compounds, bacteriocins and several enzymes is important. In this sense, lactic acid bacteria increase product shelf life and microbial innocuousness, improve texture and contribute to the pleasant sensory profile of the bakery products (Gocmen D. *et al*, 2007).

The microbiological processes that take place during yeast dough fermentation are complex and varied, with the identification of more than 50 species of lactic acid bacteria, mostly from the Lactobacillus genus, and more than 20 species of yeasts, dominated by the *Saccharomyces* and *Candida* types. The microflora of bread dough shows mainly stable associations with lactobacilli and yeasts, having important metabolic interactions that contribute to the production of flavor compounds (De Vuyst L. *et al*, 2005; Salimur-Rehman *et al*, 2006).

The dough is a mixture of flour and water, which is fermented with lactic acid bacteria, mainly heterofermentative that elaborate lactic and acetic acids in the mixture and therefore determine a pleasant sour in the final product (De Vuyst L. *et. al*., 2005).

Sourdough plays an important role in the preparation of dough for bakery products production, favoring the technological properties as it strengthens: it improves the dough prelucration, the nutritional properties (through phytate hydrolysis), the organoleptic properties (the volume of the bread, the crumb texture giving a unique flavor to the bakery products) and shelf life (Hammes P. *et al*, 1998).

The main purpose of this research was to identify the influence of the flour assortment on the quality of the natural dough and on the physico-chemical and sensory properties of the bakery products made with natural yeast.

MATERIAL AND METHOD

The present study was carried out within University of Life Sciences from Iași, in Bakery Microsection, located in Food Technology Department.

The experimental protocol consisted in obtaining two types of natural levain, respectively m_1 – with superior flour (000 type) and m_2 – with white flour (650 type) + wholemeal-flour (1350 type). The two types of sourdough were integrated into the recipes for the five experimental variants of bakery products, as follows: $m1_{650}$; $m1_{650,000}$; $m1_{000}$, $m1_{650,1350}$; $m1_{000,1350}$; $m2_{650}$; $m2_{650,000}$; $m2_{000}$, $m2_{650,1350}$ and $m2_{000,1350}$ (*figure 1*). All the experimental variants were based on the same recipe (*table 1*), with the specification that two types of natural yeast were used, which were based on two different types of flour.

In order to obtain natural levain it were followed the next work stages:

Day 1- stage I:

1. Cut the dehydrated fruit into 4 and place in a container for maceration.
2. Cover with water.
3. Cover the vessel with food foil.
4. Leave to ferment for 48-72 hours at room temperature.

The 3rd day – stage II :

1. Filter the fruit juice, recovering only the liquid which is introduced into the vat of the planetary mixer, provided with a spiral rod, adding 500 g of water, 1 kg of wheat flour type 650 and 15 g of salt.
2. Mixing
3. Discard in a plastic/stainless steel container and cover the vessel with foil/lid to prevent crusting.
4. Fermentation lasts 24 hours at temperatures 20 - 25 ° C.
5. The natural levain is ready to be used.

Several days – the IIIrd stage involves:

1. Taking the quantity of natural levain needed to obtain the bread of the day.

Refreshment:

2. Put the rest of the natural levain in the threshing pan, fix the spiral arm, add 2/3 flour type 650, 1/3 water and 15 g salt/1 kg wheat flour (similar to the model in the table describing the recipe, the natural levain column - Refreshment).
3. Dispose of in a plastic/stainless steel container and cover with foil/lid.
4. Fermentation 6 - 8 hours at temperatures of 20 - 25° C, keeping in refrigerated conditions until its subsequent use.

This study involved the sensory analysis of the 10 experimental variants. The group of evaluators was represented by specialized tasters, being thus familiar with identifying the attributes of bakery products. The preparation of the samples in order to carry out the sensory analysis consisted of cutting them in the form of a square, of equal dimensions placed on white plates.

The tasting took place in the sensory analysis laboratory, the conditions of a tasting being respected: natural light, temperature of 24ºC, no communication between the tasters.

The samples were coded accordingly and the tasters evaluated the visual, olfactory, taste and structural parameters.

The physico-chemical determinations concerned: titratable acidity, texture, porosity (%), sodium chloride content (%).

RESULTS AND DISCUSSIONS

One of the important characteristics of bread obtained with natural yeast is that it does not contain Es, growth agents, leavening agents, preservatives, food dyes and "identically natural" flavors, which through high consumption can affect the health of consumers, therefore, such bread does not present any risks that may arise under the influence of the various ingredients present in the product.

Numerous studies conducted by researchers present some information in the favor of diabetics stating that bread with natural yeast increases the blood sugar level very little, having a relatively low glycemic index.

The nutritionists present the difference between the glycemic index contained in the bread obtained with sourdough and the bread obtained with yeast, thus it was shown that a slice of 30 grams (bread with baker's yeast) has a glycemic index of 52.1 and bread with natural sourdough does not exceed a glycemic index of 34.

Table 2 shows the results obtained after determining the acidity of the 10 experimental variants, noting that the minimum values are identified by the products made with white flour, and the maximum values are recorded by the bread made with dark flour.

The minimum limit is represented by 2.04°Ac for the product $m1_{000}$ obtained from superior white flour, and the maximum by 5.94°Ac for the sample $m2_{000,1350}$. Comparing with the acidity reference values from the SP 3232/97 quality standard, which stipulates a maximum allowed limit for white bread of 3°Ac and for dark bread an interval between 6 - 6.5°Ac, it is found that most of the samples falls within the maximum allowed limits except for samples $m1_{650,000}$ and $m2_{650,000}$ which have slightly higher values.

The sodium chloride content (*table 2*) falls within the upper limit of 1.3% delimited by the sample made superior white flour 000 and dark flour 1350, and the lower limit of 0.8% delimited by the experimental sample $m2_{650,\ 000}$, obtained with the same natural yeast (m2).

After determining the porosity, it is found that the results obtained indicate a higher percentage value for white bread compared to dark bread, the minimum value being identified in the $m2_{650}$ sample of 43%, and the maximum value in the $m1_{000}$ sample of 69%.

Table 1

The recipe of natural sordough

Recipe	Percentage Weight %		
	Fruit juice	**Leaven – First weighing**	**Leaven – Refresh Second weighing**
Water, %	17	-	-
Dehydrated plums, %	2.5	-	-
Dehydrated apricot, %	2.5	-	-
Water for leaven, %	-	8.5	-
Wheat flour type 650, %	-	17	34
Salt, %	-	0.25	0.5
Leaven, First weighing, %	-	-	17
Water (±20°C), %	-	-	17
Cooling after each use			

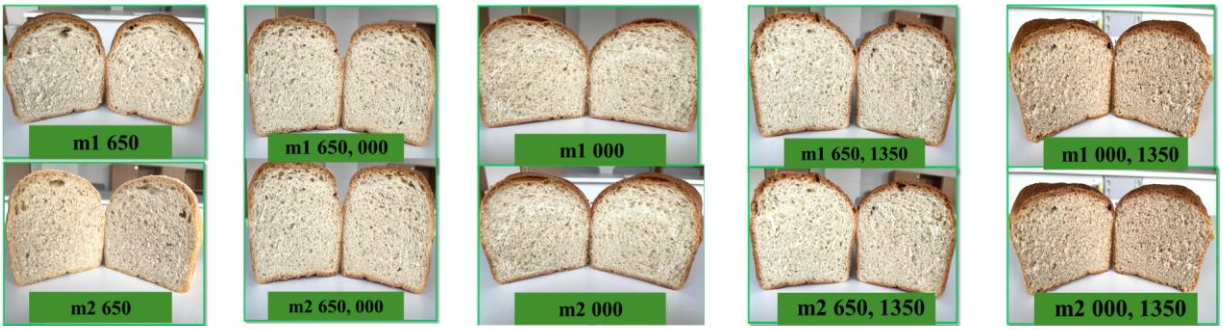

Figure 1 **Sourdough bakery product images for experimental variants with different flour sorts**

Table 2

Physico-chemical parameters of bread with natural levain

	T.A.	**pH**	**NaCl, %**	**Porosity, %**
m1 $_{650}$	2.84	5.59	0.9	67
m1 $_{650,000}$	3.12	5.56	1	66
m1 $_{000}$	2.04	5.6	0.9	69
m1 $_{650,1350}$	5.04	5.75	1.1	62
m1 $_{000,1350}$	5.55	5.82	1.05	57
m2 $_{650}$	2.64	5.66	0.9	43
m2 $_{650,000}$	3.53	5.51	0.8	45
m2 $_{000}$	2.94	5.59	0.9	49
m2 $_{650,1350}$	5.86	5.84	1.2	60
m2 $_{000,1350}$	5.94	5.91	1.3	58

Figure 2 shows the values obtained after the analysis, it can be observed the 10 samples are evaluated with high scores, but the most notable are: the $m2_{000}$ sample shows the maximum average values on the shape, but also on the color, while the minimum average values are recorded by sample $m2_{650,1350}$ on the external form. The sample $m1_{000}$ is distinguesh with the highest score for the color of the uniform crumb, but also for the external appearance.

Analyzing the graph 2 that showing the results of the olfactory analysis, the evaluators rated sample $m1_{650}$ on the specific smell with maximum average values and sample $m2_{000\ 1350}$ was evaluated with a low score for all olfactory indicators. Sample $m1_{650\ 000}$ presents a relatively high score following the analysis of the smell of fermentation, specific to bakery bread with natural sourdough. Due to the analyzed taste parameters, figure 2 shows the maximum score recorded by sample $m1_{650}$ on the characteristic taste of the product with natural sourdough, and the minimum score is identified by sample $m2_{000}$ due to the slightly acidic taste present. Also, the other samples analyzed show intermediate values. It was highlighted that the $m1_{650\ 000}$ sample was given high average values on salty taste.

The structural analysis highlights the following aspects: the $m1_{000}$ sample presents a high score on elasticity, respectively 8.83, and on the crumbly texture it has a significant result, while the $m1_{650}$ sample is scored on hardness with a relatively high score of 3.33, followed by the $m2_{000}$ sample $m2_{000\ 1350}$ due to the present characteristics evaluated by the tasters.

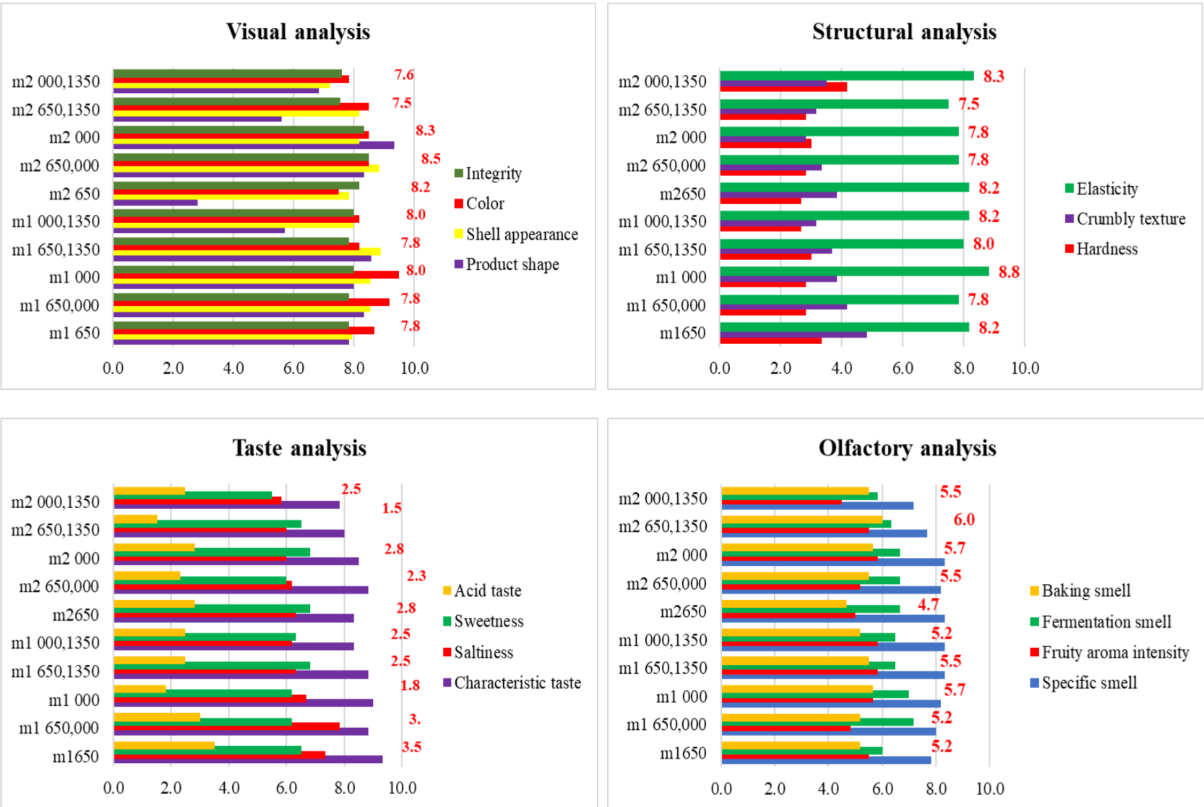

Figure 2 **The average values of sensorial characteristics**

CONCLUSIONS

Following the sensory analysis of the bakery products made with natural soudough, the following were found: the samples made with sourdough codded with 1 and white flour 650,000 distinguesh with high mean values on the external appearance, color and specific smell. Regarding the taste analysis, the ten samples obtained high average results on the characteristic taste of the products made with natural sourdough. The structural analysis highlights the following aspects: the $m1_{000}$ sample presents a high score on elasticity, respectively 8.83, and on the crumbly texture it has a significant result, while the $m1_{650}$ sample is scored on hardness with a relatively high score of 3.33, followed by the $m2_{000}$ sample ,1350 due to the present characteristics evaluated by the tasters.

From the point of view of the results obtained from the physico-chemical analyses, it is noted that the samples fall within the allowed limits with small variations on acidity and salt.

The conclusions show that this work presents the yeasts extracted from fruits as an excellent way to easily replace the commercial yeast, bringing considerable improvements in the fermentation potential, but also in the physico-chemical properties.

REFERENCES

Bordei D. 2005 - *Tehnologia modernă a panificației - Ediția a II-a,* Seria ,,Inginerie alimentară". Editura AGIR, București.

De Vuyst L., Vancanneyt M., 2007 - *Biodiversity and identification of sourdough lactic acid Bacteria*, Food Microbiology, 24(2):120-127.

De Vuyst L., Neysens P., 2005 - *The sourdough microflora: biodiversity and metabolic interactions*, Trends in Food Science & Technology, 16: 43-56.

Gobbetti M., Gänzle M., 2012 - *Handbook on sourdough biotechnology*, Springer Science & Business Media.

Ghimpețeanu O.M., Gonciarov M., 2016 - *Use of guides for good hygiene practice - a certainty for achieving safe and healthy food: A review*, Scientific Works, Series C, Veterinary Medicine, 63(1): 88-90.

Ghimpețeanu O.M., Ilie L., Neagu I., 2017 - *Evaluation of some Romanian bread products quality in correlation with food safety*, Journal of Biotechnology,. 256S, Supplement, S71.

Gocmen D., Gurbuz O., Kumral A.Y., Dagdelen A.F., Sahin I., 2007 - *The effects of wheat sourdough on glutenin patterns, dough rheology, and bread properties*. European Food Research and Technology, 225(5): 821-830.

Hümeyra I., Özmen D., Yılmaz M.T, Dertli E., 2020 - *Impact of glucan type exopolysaccharide (EPS) production on technological characteristics of sourdough bread,* Food Control, 107.

Hammes W.P., Gänzle M.G., 1998 - *Sourdough breads and related products.* In: Wood B.J.B. (eds), *Microbiology of Fermented Foods*. Chapter 8 (199–216), Springer, Boston, MA.

Murariu O.C., Irimia L., Diaconu C.M., Murariu F., 2016 - *The right of t a healthy live provided by a healthy eating support*, Universul juridic, Revista lunară.

Murariu O.C., Irimia L.M., Robu M., Isan E., 2019 - *Ensuring Nutrition Security And Sustainability Of Food Systems As Basis Of Human Healhy Life*, Proceeding of the International Scientific Congress „Life sciences, a challenge for the future"Filodiritto International Proceedings Editore, 175–180.

Murariu F., Voda A.D., Murariu O.C., 2019 - *Researches on food safety assessment - supporting a healthy lifestyle for the population from NE of Romania*, Journal of Biotechnology, Supplements, 305: S68.

Murariu O.C., Sandu A., Ghimpețeanu O.M., Petcu C.M., Puiu I., Lipșa F.D., 2021 - *Research regarding obtaining sourdough bakery products on Iași University of Life Sciences bakery micro section*, Agronomy Series of Scientific Research, 64(2): 249-252.

Murariu O.C., Petcu C.D., Ghimpețeanu O.M., Sandu A., 2022 – *The influence of growth agents on the quality of bakery products*, Agronomy Series of Scientific Research, 65(1): 45-50.

Petcu C.D., Savu C., Mitranescu E., Chirila S., 2007 - *The impelementation of the integrated quality and food safety management system in the food industry units,* 60: 545-551.

Petcu C.D., Geogescu I.M., Zvorasteanu O.V., Negreanu C.N., 2019 - *Study reffering to the appearance of contamination with deoxynivalenol in grains, grain flour and bakery products on the romanian market,* Scientific Papers. Series D. Animals Sciinces, 62(2): 241-245.

Petcu C.D., Oprea O.D., Stanciu L., Ghimpețeanu O.M., 2019 - *A study on sensorial analysis and the assessment of the nutritive values of bread assortments,* Scientific works, Series C, Veterinary Medicine, 65(1): 127-133.

Plessas S., 2021 - *Innovations in Sourdough Bread Making*, Fermentation,*7*(1):29.

Shewry P.R., America A.H., Lovegrove A., Wood A.J., Plummer A., Evans J., 2022 - *Comparative compositions of metabolites and dietary fibre components in doughs and breads produced from bread wheat, emmer and spelt and using yeast and sourdough processes,* Food Chemistry, *374*, 131710.

Salimur-Rehman, Paterson A., Piggott J.R., 2006 - *Flavour in sourdough breads: A review*, Trends in Food Science & Technology, 17(10):557–566.

Tsegaye Z., Tefera G., Gizaw B., Abatenh E., 2018 – *Characterization of yeast species isolated from local fruits used for bakery industrial application*, Journal Applied Microbiological Research, 1:21-26.