Article

The Influence of the Addition of Rosehip Powder to Wheat Flour on the Dough Farinographic Properties and Bread Physico-Chemical Characteristics

Nicoleta Vartolomei and Maria Turtoi *

Cross-Border Faculty, Dunarea de Jos University of Galati, 47 Domneasca Street, 800008 Galati, Romania; nicoleta.vartolomei@ugal.ro

* Correspondence: maria.turtoi@ugal.ro

Featured Application: Rosehip fruits have a high vitamin C content and can be used in bread-making as a natural alternative to synthetic ascorbic acid. The studied form was rosehip powder added to wheat flour and used to obtain bread with properties similar to that prepared from wheat flour with ascorbic acid as an improver.

Abstract: An in-depth analysis of wheat flour (WF) substituted with 0.5–2.5% rosehip powder (Rp) concerning the proximate composition, dough farinographic properties, and bread physico-chemical characteristics was performed. The purpose of this study was to investigate whether the use of Rp as a natural alternative for synthetic ascorbic acid in breadmaking was appropriate. A sample of wheat flour with an ascorbic acid addition of 2 mg/100 g was also used. Rp showed higher ash, carbohydrates, and fibre content, as well as lower moisture and protein content compared to wheat flour, and a vitamin C content of 420 ± 16.09 mg/100 g. A proximate composition analysis revealed a decrease in moisture, protein, and wet gluten, and an increase in ash, carbohydrates, and fibres for the flour mixtures compared with WF. Farinographic properties were positively influenced by the Rp addition and the high fibre content in the flour mixtures. Water absorption increased from 58.20% (WF) to 61.90% (2.5% Rp). Dough stability increased for the 0.5–1.0% Rp addition, then slightly decreased. The physico-chemical properties of bread prepared from flour mixtures showed a significant increase in height: 100.10 ± 0.14 mm (WF)– 115.50 ± 0.14 mm (1.5% Rp), specific volume: $142.82 \text{ cm}^3/100 \text{ g}$ (WF)– $174.46 \text{ cm}^3/100 \text{ g}$ (1.5% Rp), moisture: $41.81 \pm 0.40\%$ (WF)– $43.92 \pm 0.15\%$ (2.0% Rp), and porosity: $87.75 \pm 1.06\%$ (WF)– $89.40 \pm 0.57\%$ (2.5% Rp). The results indicated that the Rp used in breadmaking to replace synthetic ascorbic acid could be suitable.

Keywords: ascorbic acid; bread; dough; farinograph; rosehip powder; wheat flour

Citation: Vartolomei, N.; Turtoi, M. The Influence of the Addition of Rosehip Powder to Wheat Flour on the Dough Farinographic Properties and Bread Physico-Chemical Characteristics. *Appl. Sci.* **2021**, *11*, 12035. <https://doi.org/10.3390/app112412035>

Academic Editor: Silvia Mironeasa

Received: 9 November 2021

Accepted: 10 December 2021

Published: 17 December 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

As one of humanity's most important staple foods over time, bread has evolved into various forms, with distinctive and different characteristics. Bakers have made, and continue to make, traditional varieties based on accumulated knowledge, adapting existing methods and developing new ones, aiming at the best use of the available raw materials to obtain bread with the desired quality [1].

Wheat flour is the primary raw material for bread production in most of the world's regions and is a versatile raw material, accepting many additions in specific proportions [2,3]. Because the quality of wheat and flour varies greatly, improvers are added to wheat flour and dough in small amounts to obtain the desired and consistent bread quality [4]. The improver selection is made according to what needs to be improved and the flour's main technological properties, especially the power of flour and its ability to form gases to obtain the best possible result [5].

The most-used improvers in the bakery are amylolytic enzymes such as α -amylase from cereal malt [6,7], fungal α -amylase from *Bacillus subtilis* [8] or *Lactobacillus plantarum* [9], β -amylase [10], and fungal amyloglucosidase from *Aspergillus niger* [11]; as well as proteolytic enzymes such as malt proteases [12], proteases from *A. oryzae* [13] and vegetable proteases (papain, bromelain); pentosanases such as exogenous or fungal xylanases [14–16]; fungal lipases [17]; lipoxygenases from wheat or soy flour [12]; transglutaminase produced by the bacterium *Streptovorticillium* [12]; cellulases [10]; natural emulsifiers such as lecithin from oil demucilagination [18,19]; synthetic emulsifiers such as polyalcohol esterified with paraffin chains [20]; oxidizing agents such as L-ascorbic acid (E300) [21], KBr (E924) [22,23], KI (E917) [24]; and reducing agents such as L-cysteine [25].

Ascorbic acid (AA) has been used as an improver in breadmaking since 1935 [26]. AA is added either into flour or directly into the dough. The role of AA in baking is to mediate the oxidation reactions that stabilise the dough for preserving its elastic and viscous properties so that the dough can retain gases and go through the stages of the breadmaking process (stretching, shaping, etc.) [26,27]. In addition to improving the ability of gluten to retain gases, ascorbic acid also contributes to faster proofing, as well as obtaining a piece of bread with a larger volume, a more delicate crumb, smaller and more pores, and to reduce the thickness of the bread crust. These changes also result in a softer crumb, making the bread look fresh for longer [28].

Although AA, the reduced form of vitamin C, is naturally present in many fruits and vegetables, most of the AA that supplies the bakery industry is obtained through chemical reactions that use glucose as a raw material [29]. Therefore, AA is classified as the chemical compound, E300 [30].

Sahi [31] presented some research results performed at Campden BRI, UK, where synthetic AA was replaced with AA-rich plant materials. Acerola cherry (*Malpighia emarginata*) extract was used in the research. Disclosed experimental data showed that the addition of acerola cherry extract leads to a dough with good farinographic properties. Thus, the dough development time was equal to that obtained for the control sample with synthetic AA. The softening degree in kneading tests in the farinograph was reduced to 64 Brabender Units (BU) but was close to dough with synthetic AA (70 BU) and lower than the control (120 BU). The bread volume, crumb structure, and texture were similar to bread obtained with chemical AA [31]. This research paved the way for more extensive possibilities of plant material selections to replace synthetic AA, especially when a clean label is desired [31].

Fruits of rosehip (*Rosa canina* L.) are recognised as a vegetal source rich in vitamin C, with the content in fresh rosehip varying between 100 and 1.400 mg/100 g (0.1–1.4%), with average values of 400–800 mg/100 g [32,33].

Rosehip fruits have been used, as a powder or an extract, in various formulas in baking to enhance the bread's nutritional value [34–36]. However, no research or trial has been developed to investigate the replacement of synthetic AA with rosehip fruits. Therefore, the research presented in this work is original and aims to study the influence of the rosehip powder (Rp) addition as a natural substitute for synthetic AA on the dough farinographic properties and bread quality.

2. Materials and Methods

2.1. Materials

The white wheat flour (WF, type 550) was purchased from Dizing SRL, Brusturi, Neamt County, a local milling and breadmaking company. It was not treated with ascorbic acid or other improvers.

The rosehip (*Rosa canina* L.) fruits were collected from the Dofteana area, Bacau County, at the maturity stage to benefit from the higher content of bioactive compounds. After discarding the achenes (the real fruits) containing the seeds, the dried sepals, and the remainder of anthers and filament, the hypanthium (fleshy shell or pulp) was dried in the dark at atmospheric conditions to avoid the loss of vitamins. The dried pulp of rosehip fruits was ground by an ultra-centrifugal laboratory mill, ZM 200 Retsch (18.000 rpm,

4 min) to obtain the Rp, then was sieved to select the particles around 180 µm in size, similar to wheat flour granularity. The obtained Rp was stored in airtight brown glass jars in the dark and was kept cold until use.

The Rp additions were selected based on the regular supplementation of wheat flour with ascorbic acid and the vitamin C content of Rp. Usually, the wheat flour is supplemented with 2 to 10 g ascorbic acid per 100 kg flour (10 mg/100 g), where the higher quantities in the interval are used for flour with lower quality indicators. Calculations based on the vitamin C content of Rp, just before the addition to flour (420 ± 16.09 mg/100 g), served to select the Rp addition levels used in the research, which were 0.5–2.5%.

Other ingredients used for breadmaking, i.e., salt and compressed yeast, were purchased from the local market (Bacau, Romania). Pakmaya compressed yeast was produced by Rompak SRL, Pascani, Iasi County, Romania.

Ascorbic acid was purchased from Enzymes & Derivates, Costișa, Neamt County, which is a local supplier of ingredients for the food industry.

Chemicals and reagents, such as ethanol (C_2H_5OH , with a minimum of 95% *w/w*), concentrated sulphuric acid (98%), copper sulphate ($CuSO_4 \cdot 5H_2O$), boric acid (H_3BO_3), chlorhydric acid, and borax ($Na_2B_4O_7 \cdot 10H_2O$) of an analytical grade were purchased from Merck (Darmstadt, Germany). Calcium chloride, sodium hydroxide, sodium chloride, and phenolphthalein of an analytical grade were purchased from Sigma-Aldrich (Steinheim, Germany).

2.2. Proximate Compositions

The proximate compositions of WF, Rp, and mixtures of wheat flour with 0.5%, 1.0%, 1.5%, 2.0%, and 2.5% of Rp were determined according to the official methods of analysis from the Association of Official Analytical Chemists [37] and the American Association of Cereal Chemists International [38], and in force standards, as follows: moisture content (SR 90:2007 [39]), ash content (SR EN ISO 2171:2010 [39]), protein content (SR EN ISO 20483:2014 [39]) through the Kjeldahl method using a nitrogen-to-protein conversion factor of 6.25 for Rp and 5.7 for wheat flour and flour mixtures (AACC method 46-11.02 [38]), lipids through an organic solvent extraction (Soxhlet method) (AOAC method 983.23 [37]), carbohydrates through the Luff–Schoorl iodometric method (AOAC method 920.183 [37]), wet gluten (SR 90:2007) [39], dry gluten (SR EN ISO 21415-3:2007) [39], the gluten deformation index, acidity, the sedimentation index, granularity (SR 90:2007) [39], and ascorbic acid (vitamin C) through the indophenol method (AOAC method 967.21 [37]).

2.3. Farinographic Measurements

The Brabender farinograph (Brabender Model E, Duisburg, Germany), according to SR EN ISO 5530-1:2015 [39] and the AACC method 54-21 [38], was used to determine the dough farinographic properties, namely: water absorption (WA in %), dough development time (DT in min), dough stability (DS in min), the softening degree (SfD in BU), and the Farinograph quality number (QN).

2.4. The Breadmaking Procedure

The doughs were prepared with the direct (one-stage) method (SR 91:2007 [39]) using the following recipe per 100 g of wheat flour: 1.5% salt, 1.8% compressed baker's yeast, 0–2.5% Rp, and water (58–65 mL), according to the water absorption of each mixture of WF and Rp. The quantities were calculated for 3 kg of wheat flour to obtain around 5 kg of dough. Mixing and kneading were performed in a Diosna dough mixer with a removable bowl, a 12 kg maximum dough capacity, and 0.44/0.9 kW of motor power. After 10 min of kneading, the dough was fermented for 150 min at 28–30 °C in the mixing bowl, divided into pieces of 380 g, moulded, and introduced into baking trays. After the additional 50–60 min of leavening at 30 °C in a continuous proofer, the samples were baked for 20 min at 230–240 °C. Proofing and baking were accomplished on the technological flow of the Dizing breadmaking company.

2.5. Bread Characterization

The bread samples were stored for 120 min at room temperature before analysis.

The physico-chemical analysis of bread samples included the determination of the bread height, moisture, porosity, elasticity, and acidity of the crumb (SR 91:2007 [39]), as well as measuring the volume through the rapeseed displacement method (SR 91:2007 [39]).

2.6. Statistical Analysis

The results are reported as the average values of two or three replicates, along with their standard deviations (three replicates, especially for Rp and sensitive analyses). A one-way analysis of variance (ANOVA) was carried out with the Microsoft Excel programme, Microsoft Office 2010, to detect significant differences among results. Fisher's least significant difference (LSD) test at a 95.0% confidence level, used to determine differences between values, was applied using the Statgraphics Centurion XVI.I software (Statgraphics Technologies, Inc., The Plains, Virginia, USA).

3. Results and Discussion

3.1. The Proximate Composition of the Flours

The proximate compositions of Rp, WF, and the flour mixtures (WF-Rp) obtained with the addition of 0.5–2.5% are shown in Table 1.

Table 1. Proximate composition of rosehip powder, wheat flour, and flour mixtures.

Samples	Moisture, %	Ash, %	Proteins, %	Wet Gluten, %	Carbohydrates, %	Fibres, %	Vitamin C, mg/100 g
Rp	13.40 ± 0.15 a	6.50 ± 0.07 b	4.89 ± 0.11 a	–	73.66 ± 0.19 b	8.63 ± 0.12 b	420 ± 16.09 b
WF	14.15 ± 0.06 b	0.55 ± 0.01 a	13.45 ± 0.03 b	34.10 ± 0.07 c	70.68 ± 0.29 a	0.10 ± 0.07 a	–
WF-Rp 0.5%	14.14 ± 0.01 b	0.59 ± 0.04 a	13.42 ± 0.05 b	33.93 ± 0.16 bc	70.74 ± 0.51 a	0.12 ± 0.05 a	2.0 ± 0.20 a
WF-Rp 1.0%	14.14 ± 0.01 b	0.61 ± 0.04 a	13.36 ± 0.04 b	33.76 ± 0.09 abc	70.83 ± 0.32 a	0.14 ± 0.11 a	4.0 ± 0.36 a
WF-Rp 1.5%	14.14 ± 0.01 b	0.64 ± 0.06 a	13.32 ± 0.07 b	33.59 ± 0.15 abc	70.85 ± 0.15 a	0.16 ± 0.07 a	6.0 ± 0.30 a
WF-Rp 2.0%	14.13 ± 0.02 b	0.67 ± 0.06 a	13.27 ± 0.05 b	33.42 ± 0.19 ab	71.00 ± 0.17 a	0.18 ± 0.09 a	8.0 ± 0.17 a
WF-Rp 2.5%	14.13 ± 0.01 b	0.70 ± 0.07 a	13.21 ± 0.04 b	33.25 ± 0.07 a	71.04 ± 0.23 a	0.20 ± 0.06 a	10 ± 0.26 a
WF-AA	14.15 ± 0.05 b	0.55 ± 0.02 a	13.45 ± 0.04 b	34.10 ± 0.09 c	70.68 ± 0.14 a	0.10 ± 0.06 a	2.0 ± 0.00 a

WF—wheat flour, Rp—rosehip powder, WF-Rp—mixtures of wheat flour with rosehip powder, WF-AA—wheat flour with ascorbic acid addition of 2 mg/100 g. Different letters within the column indicate the values are statistically different at a 95.0% confidence level.

Rp showed a vitamin C content of 420 ± 16.09 mg/100 g, which belonged to the interval of 100–1.400 mg/100 g [32,33,40–43]. Moreover, Rp contains a high ash content, indicating a high mineral salts content, low protein content, and high levels of fibres and carbohydrates (Table 1).

Because Rp has a moisture content ($13.40 \pm 0.15\%$) lower than wheat flour ($14.15 \pm 0.06\%$), the addition of Rp in wheat flour resulted in a slight decrease in the moisture of the flour mixtures as the added amount of Rp increased. Thus, the lowest values of moisture (14.13%) were obtained with the addition of 2.0 and 2.5% of Rp into the wheat flour. According to the ANOVA, the differences between the moisture values of the samples were not significant ($p > 0.05$). This finding is due to the small amounts of the Rp additions. The results are consistent with other literature [44,45].

The results presented in Table 1 indicated that due to the increase of the Rp addition, the ash content increased from $0.55 \pm 0.01\%$ in the control to $0.70 \pm 0.07\%$ in the sample with 2.5%. The ash content of the Rp used was $6.5 \pm 0.07\%$ which explains the ash increase in the flour mixtures. The results are similar to other data presented in the literature. Koletta et al. [46] reported an ash content of 0.63% in wheat flour and 1.26% in barley flour, and Cvetković et al. [47] obtained an ash content of 3.71% in dried rosehips.

The protein content (Table 1) of the flours decreased from $13.45 \pm 0.03\%$ in the control to $13.21 \pm 0.04\%$ in the sample with 2.5% Rp, i.e., a reduction of 1.78% compared to the control sample. This decrease is due to Rp, which has a lower protein content ($4.89 \pm 0.11\%$) than wheat flour.

Van Hung et al. [48] studied the quality of dough and bread made from whole wheat flour, intending to delay the ageing of bread. The wholemeal flour with which the studies were carried out had a significantly higher protein content than commercially available white wheat flour (13.5% compared to 12.6%).

Dall'Asta et al. [49] reported a study on the influence of a chestnut flour addition to white wheat flour on the bread's physicochemical properties and volatile components. The mixtures made were 80/20 and 50/50 white soft wheat flour/chestnut flour, with white flour alone as the control sample. As chestnut flour has a lower protein content than wheat flour, the obtained mixtures also had a lower protein content than the control sample. Thus, the protein content ranged from 13.2% for wheat flour to 5.8% for the 50/50 wheat flour/chestnut flour mixture.

According to the ANOVA, the differences between the protein content of WF and WF-Rp were not significant ($p > 0.05$).

The lipid content of Rp was $0.76 \pm 0.05\%$, quite close to that of WF ($0.83 \pm 0.07\%$). The flour mixtures showed lipid contents situated between these values, almost without any variation, as the ANOVA analysis confirmed ($p > 0.05$) (data not shown).

A study by Sun et al. [50], regarding the addition of wheat germ flour (3%, 6%, 9%, and 12%) to white flour to obtain Chinese steamed bread, does not mention the lipid content of the resulted mixtures, only that of white flour (1.3%).

The different evolutions of lipid content could be achieved when the ingredients used have higher values. Pınarlı et al. [51] obtained pasta (macaroni) from durum wheat flour (semolina) mixed with 15% wheat germ, obtaining a significant improvement in nutritional value. Other authors, e.g., Arshad et al. [52] mentioned that they replaced up to 25% of wheat flour with defatted wheat germ and obtained improved functional and nutritional properties for prepared cookies.

The carbohydrate content for the control sample and flour mixtures had a very slight growth tendency with increased amounts of Rp added (Table 1). Wheat flour has a carbohydrate content of $70.68 \pm 0.29\%$ and Rp has a carbohydrate content of $73.66 \pm 0.19\%$. The highest value of carbohydrate content, 71.04%, was obtained with the addition of 2.5% Rp, representing an increase of only 0.51% compared to the carbohydrate content of the control sample. According to the ANOVA analysis, this variation was not significant ($p > 0.05$) compared to the carbohydrate content of the control sample because the Rp was added in tiny proportions.

The fibre content of WF-Rp varied with Rp addition values, increasing by about 0.02% for every 0.5% of Rp added, from $0.1 \pm 0.07\%$ in white flour to $0.2 \pm 0.06\%$ in the mixture with an addition of 2.5% Rp. According to the ANOVA single-factor statistical analysis, the differences were not significant ($p > 0.05$).

The total fibre content of whole wheat flour obtained by Van Hung et al. [48] was 15.3%, divided into 11.2% insoluble and 4.1% soluble fibres. The white wheat flour used in their research contained 3.4% total fibre with 1.6% insoluble and 1.8% soluble fibres because most of the fibre, both soluble and insoluble, was removed with bran and germs. The authors [48] believed that wholemeal wheat flour with a high fibre content, especially insoluble fibre, is a suitable raw material for high-fibre foods. However, these authors found that a high fibre content dilutes gluten proteins during dough kneading, leading to a soft and inelastic dough. Thus, bread made from whole wheat flour has a significantly smaller specific volume and larger pores than bread made from white flour [48].

The wet gluten in flour mixtures with Rp varies inversely with the addition of Rp, decreasing from $34.10 \pm 0.07\%$ in the control sample to $33.25 \pm 0.07\%$ with a 2.5% addition of Rp due to the absence of gluten-forming proteins in Rp. According to the single-factor ANOVA statistical analysis, the variation was not significant ($p > 0.05$), with the decrease of gluten content representing about 0.17% at each addition stage.

Banu et al. [44] found a reduction in wet gluten from $25.0 \pm 0.15\%$ for the control sample–white wheat flour to $24.4 \pm 0.19\%$, $24.2 \pm 0.19\%$, $24.1 \pm 0.17\%$, $22.9 \pm 0.16\%$, $21.0 \pm 0.15\%$, $19.9 \pm 0.15\%$, and $18.4 \pm 0.14\%$ for mixtures of white wheat flour with wheat

flour bran (3%, 5%, 10%, 15%, 20%, 25%, and 30%, respectively), the variations being significant ($p < 0.05$). The reduction of wet gluten is greater in this study due to the higher additions of wheat flour bran.

The sedimentation index, a parameter that reflects the quantity and quality of proteins in flour (wheat), increased from 25.0 for wheat flour to 29.0 for flour mixtures with 1.5% and 2.5% Rp, respectively, the variations being significant ($p < 0.05$). These values are in the range of 20–39, corresponding to a good quality flour for baking [4]. The additions of Rp in white wheat flour had tiny values (0.5–2.5%), and the protein content and wet gluten varied very little. Therefore, it could be stated that the addition of Rp did not affect the quality of proteins in WF. However, the sedimentation index increased almost linearly for the first mixtures, namely, the samples with a 0.5–1.0% Rp addition (27.0 and 28.0) and stagnated for the subsequent three samples (29.0), namely, those with a 1.5%, 2.0%, and 2.5% Rp addition (data not shown in Table 1).

The vitamin C content in flour mixtures (Table 1) reflected the addition of 0.5–2.5% of Rp in wheat flour to obtain the mixture flours. The differences were significant ($p < 0.05$). It is equal to (0.5% Rp), or higher than, the usual AA addition to dough in breadmaking when WF has a good quality. AA is a pure and more stable compound than vitamin C in Rp, which can be degraded easily during storage time.

3.2. Dough Farinographic Properties

The farinographic properties of the dough, namely, water absorption, the dough development time, stability, softening degree, and the farinograph quality number are presented in Table 2.

Table 2. Farinographic properties of doughs.

Samples	Water Absorption (500 BU), %	Dough Development Time, min	Stability, min	Softening Degree (12 min after Maximum), BU	Farinograph Quality Number
WF	58.20 ± 0.00 a	6.70 ± 0.00 a	11.00 ± 0.00 a	58.00 ± 0.00 a	116.00 ± 0.00 a
WF-Rp 0.5%	59.70 ± 0.14 b	6.75 ± 0.49 a	11.50 ± 0.42 a	58.50 ± 0.71 a	125.50 ± 6.36 a
WF-Rp 1.0%	60.35 ± 0.07 c	6.60 ± 0.14 a	11.30 ± 0.71 a	65.00 ± 2.83 a	122.50 ± 0.71 a
WF-Rp 1.5%	60.80 ± 0.00 d	6.70 ± 0.42 a	11.20 ± 1.13 a	78.00 ± 1.41 b	118.00 ± 0.00 a
WF-Rp 2.0%	61.25 ± 0.07 e	7.10 ± 0.14 a	10.55 ± 0.07 a	87.00 ± 1.41 c	116.50 ± 0.71 a
WF-Rp 2.5%	61.90 ± 0.00 f	7.20 ± 0.14 a	9.70 ± 0.14 a	91.00 ± 1.41 c	115.50 ± 4.95 a
WF-AA	58.20 ± 0.00 a	6.60 ± 0.14 a	11.20 ± 0.00 a	60.00 ± 1.41 a	121.00 ± 1.41 a

WF—wheat flour, Rp—rosehip powder, WF-Rp—mixtures of wheat flour with rosehip powder, WF-AA—wheat flour with ascorbic acid addition of 2 mg/100 g. Different letters within the column indicate the values are statistically different at a 95.0% confidence level.

Bread dough is a viscoelastic material that shrinks when sheared, combining Hooke's solid and a non-Newtonian viscous liquid. It has a non-linear rheological behaviour but, at very low stresses, it has a linear behaviour. The stress at which the dough has a linear behaviour depends on the type of dough, the mixing method, and the testing method [53]. Information on the rheological properties of the dough helps predict potential applications of wheat flour and the quality of the finished product [54].

The farinograph, a physical dough testing device, was used to assess how adding Rp to wheat flour affected the rheological properties of the dough. It allowed for the evaluation of the performance of flour mixtures and the breadmaking potential. The two z-shaped blades of the farinograph mixer rotate at constant speeds and subject the dough to mixing at a constant temperature [54].

3.2.1. Water Absorption

Flour hydration is essential because it affects the functional properties and the quality of bread [55,56].

The water absorption of the wheat flour and flour mixtures, corrected for 500 BU (Table 2), showed a linear ($R^2 = 0.94$) increase with the increase of the Rp addition to the flour, from $58.20 \pm 0.00\%$ for the control to $61.90 \pm 0.00\%$ for the 2.5% Rp addition. According to the ANOVA single-factor statistical analysis, the differences were significant

($p < 0.05$). The control sample with AA at 10 g/100 kg showed a water absorption identical to that of the control sample.

The increase in water absorption is widely discussed in the literature. Thus, numerous papers mention the positive influence of protein quantity and quality on water absorption [55,57–59]. Moreover, Hefnawy et al. [60] and Mohammed et al. [61] reported increased water absorption with increased protein content with chickpeas in wheat flour.

Since the addition of Rp to wheat flour decreased the protein content of the flour mixtures, the reason for the increase in water absorption must be sought somewhere else, for example, in the influence of fibre content. Gómez et al. [62] added purified fibres of various origins (oranges, peas, cocoa, coffee, wheat, and microcrystalline cellulose) to wheat flour bread. They obtained an increase in water absorption with an increase in the percentage of added fibres. For example, with the addition of 2% and 5% orange fibre, the water absorption was 63.00% and 65.40%, respectively, compared to 58.70% in the control sample (white wheat flour). The water absorption capacity increased with the addition of fibres due to the hydroxyl groups in the chemical structure of the fibres that allows the binding of water through hydrogen bonds [62]. Many other researchers have come to the same conclusion. Thus, introducing high-fibre wheat bran to white wheat flour increased the water absorption from $57.10 \pm 0.20\%$ in the control sample to $68.20 \pm 0.60\%$ for an addition of 30% wheat bran [44]. Similarly, Lauková et al. [63] obtained an increase in water absorption from $58.00 \pm 0.70\%$ for the control sample to $75.30 \pm 0.70\%$ for an addition of 15% hydrated apple powder. Similar results were reported by Kohajdová et al. [64] with the addition of carrot powder (water absorption increased from $60.67 \pm 0.35\%$ for the control sample to $72.01 \pm 0.25\%$ for a 15% addition of carrot powder) and Ajila et al. [65] with the addition of mango peel powder (water absorption increased from 60.00% for the control sample to 68.00% for a 10% addition of mango peel powder).

3.2.2. Dough Development Time

The dough development time (DT) is measured by adding water to the flour until the dough reaches its maximum consistency without breaking. Water hydrates the flour components during the mixing phase, and the dough develops [63].

The DT for the control sample was 6.70 ± 0.00 min and varied between 6.60 ± 0.14 min (1.0% Rp) and 7.20 ± 0.14 min (2.5% Rp) for the flour mixtures. According to the ANOVA, the differences were not significant ($p > 0.05$), although close to the limit ($p = 0.054$), so the Rp addition had a relatively small influence on DT (Table 2). The wheat flour control sample with the AA addition had a DT of 6.60 ± 0.14 min, lower than the WF control, reflecting that the AA addition to the flour reduces the DT.

A similar effect of DT variations has been reported in several studies. Sudha et al. [66] observed an increase in DT from 1.5 min (control sample) to 3.5 min (an addition of 15% apple pomace with dietary fibre resulting from the manufacture of apple juice), Lauková et al. [63] found an increase in DT from 3.5 min. (control sample) to 11.0 min for an addition of 15% hydrated apple powder in white wheat flour, and Kohajdová et al. [67] observed an increase in DT from 3.43 min (control sample) to 5.53 min (an addition of 15% apple powder).

Kučerová et al. [68] added different Vitacel brand fibres (JRS Company, Rosenberg, Germany) to the wheat flour. They found a slight increase in DT with an increasing fibre addition from 1% to 3%, compared to wheat flour, as follows: from 1.1 min to 1.3 min for wheat fibre (WF 200), 1.5 min to 1.7 min for apple fibre (AF 400), 1.9 min to 2.2 min for potato fibre (PF 200), and from 1.3 min to 1.5 min for bamboo fibre (BF 300).

In the given examples, it is observed that although the DT has increased in direct proportion to the fibre additions, the differences are tiny. Nikolić et al. [69] made a similar statement for flour mixtures with variable buckwheat flour additions. They reported an increase of DT from 1.0 min to 1.2 min for buckwheat flour additions ranging from 1 g/100g to 20 g/100 g flour mixtures and a maximum value of 1.5 min for 30 g/100 g.

The increase in DT was explained by the slowdown in hydration rate and gluten development due to adding ingredients that increased the fibre content in the mixtures obtained [63,66].

3.2.3. Dough Stability

The data relating to the influence of the Rp addition on dough stability (DSt) are shown in Table 2. DSt increased from 11.00 ± 0.00 min (WF control) to 11.50 ± 0.42 min (0.5% Rp), then decreased below the value for the control sample, reaching 9.70 ± 0.14 min for 2.5% Rp. The DSt of the control WF with added AA was 11.20 ± 0.00 min, a little higher than the DSt of the WF sample. According to the ANOVA, the differences were significant ($p < 0.05$).

DSt provides some indications regarding the tolerance of flour to mixing and kneading [70]. Thus, Nassar et al. [71] reported the increase of DSt from 4.9 min for the control sample to 12.4 min and 11.5 min with the addition of 25% flour from orange peels and orange pulp, respectively. The same effect was observed by Kohajdová et al. [72], who reported an increase in DSt after the addition of apple fibre from 6.40 ± 0.15 min for the control sample, to 9.30 ± 0.64 min for the mixture with 15% apple fibre, and from 9.40 min to 10.90 min with the addition of 15% apple pomace fibre [67]. Moreover, Lauková et al. [63] reported a significant increase in DSt from 6.7 min for the control sample to 11.6 min with an addition of 15% hydrated apple powder. These authors explained the rise of DSt through a higher interaction of fibres, water, and proteins in flour [63,67]. On the other hand, the DSt in this research was considerably higher than the values obtained by adding buckwheat flour, in which case the DSt increased from 0.3 ± 0.1 min for the control sample to 4.6 ± 0.3 min with an addition of 30 g of buckwheat flour/100 g of wheat flour [69]. The opposite effect was reported by Sudha et al. [66] after adding apple pomace powder to the wheat flour in different proportions. Thus, the DSt decreased from 4.2 min to 2.1 min with an addition of 15% apple pomace fibre. These results are supported by Rosell et al. [73], who observed a decrease in DSt with increased additions (12.5–25%) of quinoa flour to wheat flour, and Liu et al. [74] reported a reduction in DSt of up to 30% for potato flour additions to wheat flour.

3.2.4. Softening Degree

The softening degree (SfD) in BU is determined from farinograms 10 min after the start of the experiment (data not shown) and 12 min after the curve reached the maximum (Table 2). An ascending variation of SfD at 12 min was obtained for increased Rp additions to the wheat flour. The SfD increased linearly ($R^2 = 0.95$) from 58.00 ± 0.00 (control) to 91.00 ± 1.41 (2.5% Rp). According to the ANOVA, the differences were significant ($p < 0.05$).

There were no findings regarding the degree of softening resulting from the farinographic analysis in the studies mentioned above [44,55,59,62–69].

Instead, other researchers have mentioned a decrease in SfD. For example, Anil [75] observed a reduction in the SfD from 78.0 ± 2.0 BU for the control to 61.0 ± 1.0 BU and 39.0 ± 2.0 BU for the addition of 5.0 and 10.0% crushed and roasted hazelnut powder, respectively. Moreover, Stojceska & Ainsworth [76] noticed an increase in DT and DSt and a decrease in SfD from 25 UB for the control sample to 15, 20, and 5 UB for 10%, 20%, and 30%, respectively, with the addition of brewers spent grains to wheat flour. It should be noted that the proportions of spent grains used in this research were much higher than 0.5–2.5% Rp and could help in increasing the SfD. In another study [77], the authors observed a decrease in the SfD from 60.0 ± 1.0 UB for the control to 20.0 ± 2.0 UB for the samples with additions of fibre concentrates from the pulp of dates, pears, and apples in proportions that ensured a 2% fibre intake.

3.2.5. The Farinograph Quality Number

The values of the farinographic quality number (QN), resulting from Rp additions, are presented in Table 2. It was observed that the QN of samples with added Rp were generally higher than the control sample, except for the sample with an addition of 2.0% Rp, which had the same value (116). The dough obtained from WF with 2 g AA/100 g had a QN equal to 121, between 1.0% and 1.5% Rp. However, the differences were not significant ($p > 0.05$).

Although no clear correlation can be established between the addition of Rp and the value of the QN, the fact that the QN was higher than the control sample showed that the Rp addition had a positive influence on the QN. This statement is consistent with findings observed by Nikolić et al. [69], who obtained a QN of 52.8 ± 2 for wheat flour (control) and increased values of 67.8 ± 2 for 30% buckwheat flour/100 g flour mixture.

3.3. Bread Characterization

The physico-chemical properties of bread made from WF, WF-Rp, and WF with AA as the improver are shown in Tables 3 and 4.

Table 3. Physical properties of bread (height, weight, and volume).

Samples	Height, mm	Volume, cm ³	Weight, g	Specific Volume, cm ³ /100 g
WF	100.10 ± 0.14 b	486 ± 4.24 a	340.30 ± 1.84 ab	142.82 a
WF-Rp 0.5%	98.75 ± 0.49 a	481 ± 5.66 a	338.10 ± 1.56 ab	142.27 a
WF-Rp 1.0%	113.05 ± 0.07 e	588 ± 4.24 bc	339.00 ± 1.41 ab	173.45 c
WF-Rp 1.5%	115.50 ± 0.14 f	601 ± 5.66 c	344.50 ± 2.12 b	174.46 c
WF-Rp 2.0%	111.15 ± 0.21 d	575 ± 4.95 bc	333.00 ± 1.41 a	172.52 c
WF-Rp 2.5%	108.25 ± 0.07 c	564 ± 5.66 b	337.60 ± 1.56 ab	167.06 b
WF-AA	113.90 ± 0.28 e	588 ± 4.24 bc	336.90 ± 0.85 ab	174.53 c

WF—wheat flour, Rp—rosehip powder, WF-Rp—mixtures of wheat flour with rosehip powder, WF-AA—wheat flour with ascorbic acid addition of 2 mg/100 g. Different letters within the column indicate the values are statistically different at a 95.0% confidence level.

Table 4. Physico-chemical properties of bread crumb.

Samples	Moisture, %	Acidity, Degree	Porosity, %	Elasticity, %
WF	41.81 ± 0.40 a	2.00 ± 0.00 a	87.75 ± 1.06 a	93.30 ± 0.58 d
WF-Rp 0.5%	42.64 ± 0.33 abc	2.10 ± 0.00 a	87.50 ± 0.71 a	91.70 ± 0.58 bcd
WF-Rp 1.0%	42.92 ± 0.22 abc	2.15 ± 0.07 a	90.00 ± 0.71 a	91.50 ± 0.50 bcd
WF-Rp 1.5%	43.31 ± 0.10 bc	2.15 ± 0.07 a	90.70 ± 0.99 a	91.00 ± 0.50 bc
WF-Rp 2.0%	43.92 ± 0.15 c	2.20 ± 0.14 a	89.00 ± 0.71 a	90.30 ± 0.58 ab
WF-Rp 2.5%	42.51 ± 0.34 abc	2.25 ± 0.07 a	89.40 ± 0.57 a	88.50 ± 0.50 a
WF-AA	42.06 ± 0.16 ab	2.15 ± 0.07 a	88.60 ± 1.56 a	92.30 ± 0.58 cd

WF—wheat flour, Rp—rosehip powder, WF-Rp—mixtures of wheat flour with rosehip powder, WF-AA—wheat flour with ascorbic acid addition of 2 mg/100 g. Different letters within the column indicate the values are statistically different at a 95.0% confidence level.

3.3.1. Bread Dimensions

Although the dough was baked in trays, the bread dimensions were measured. It was observed from the beginning that the leavening was differentiated, resulting in pieces of bread of different heights, most likely due to the Rp addition's influence. The values of length (around 235 mm) and width (about 91 mm) of bread did not differ significantly ($p > 0.05$) due to baking in trays. In contrast, the height of the loaves, determined as an average of two duplicates, showed significant differences ($p < 0.05$) (Table 3).

3.3.2. Bread Volume

The volume and specific volume of bread are reported in Table 3.

The bread volume had higher values for samples with added Rp compared to the control ($486 \pm 4.24 \text{ cm}^3$), except for the addition of 0.5% Rp. The most significant increase in volume was observed for 1.0% and 1.5% Rp, while for the following additions, there was a slight decrease, but the values remain higher than for control. The bread volume with ascorbic acid (WF-AA) had a value between the bread volumes with the addition of 1.0% and 2.0% Rp. According to the ANOVA, the differences were significant ($p < 0.05$). The increase in bread volume could be explained by the Rp addition, which provided the dough with a specific content of AA that contributed to dough stabilization, gluten network strengthening [26,27], and a larger volume of bread [28].

The bread volume is, for most consumers, one of the main criteria for evaluating the bread quality and is implicitly one of the primary decision-making elements of purchasing. Hathorn et al. [78] considered that the importance of bread volume for consumers derives from their desire to consume bread that seems light and not too dense. Thus, even if a large volume is not desirable, consumers associate large volumes with some loaves of bread and small values with others, e.g., flat chapatti, Lebanese bread, and pita bread.

From a technological point of view, the bread volume is an essential external feature as it represents a quantitative measure of the performance of the baking process [79]. The bread volume depends on the quantity and quality of gluten [73] and how the dough is processed. Thus, a well-kneaded and developed dough with a well-formed gluten network will reduce the loss of gas and contribute to an increased bread volume [1]. Moreover, the volume of bread correlates with the moisture of the dough. Thus, Gallagher et al. [80] stated that higher moisture located in the optimal area positively influences bread volume because the bread will have an increased volume.

Osuna et al. [81] studied the composition, sensory properties, and the effects of ascorbic acid and α -tocopherol additions on the oxidative stability of wholemeal bread and vegetable oils. Although they stated that adding AA contributed to increasing the bread volume by improving the dough's stability, the authors did not determine the specific volume or bread volume.

Hallén et al. [82] added chickpea flour obtained from grains, germinated and fermented, in a proportion of 5%, 10%, and 15% to wheat flour. For some additions they obtained increases in the volume of bread loaves compared to the control (1560 mL), for example, an increase up to 1657 mL for the addition of 5%, 1598 mL for 10%, and 1627 mL for 15% chickpea flour; 1667 mL for 5% and 1587 mL for 10% germinated chickpea flour; and 1710 mL for 5% and 1680 mL for 10% fermented chickpea flour. For the rest of the additions, the specific volume was lower than the control. Most of the volume increases were small because the addition of chickpea flour resulted in a stickier dough that was more difficult to process, especially in the case of sprouted chickpeas, due to the reduced content of gluten-forming proteins. The bread obtained was generally more compact, with a denser structure [82].

In a similar study, McWaters et al. [83] added chickpea flour from raw and extruded grains in 15% and 30% proportions. They recorded a decrease in volume for all additions compared to the control. The reduction in volume was higher for the 30% addition compared to 15%, and the reduction in volume was also higher for the flour from extruded chickpea grains due to the decrease in the content of gluten-forming proteins even if the total protein content of the flour mixes increased.

Van Hung et al. [48] stated that the addition of fibre dilutes proteins and interferes with forming the optimal gluten network, confirming the previous statements.

Yamasaengung et al. [84] continued these studies by combining chickpea flour with emulsifiers. If no emulsifier was added to the white bread, the specific volume of the bread was significantly smaller ($p < 0.05$). Therefore, they stated that only emulsifiers significantly affected the specific volume of white bread ($p < 0.05$). The decrease in bread volume caused by chickpea flour can be counteracted by increased water in the dough. In wholemeal bread, the volume increase is influenced by a combined effect of water and emulsifiers [84].

In general, bread volume is correlated with a soft texture and high porosity, while bread density refers to a more compact, harder-textured bread [84].

The inverse of the density, expressed in g/cm^3 , is the specific volume in cm^3/g . This parameter results from the calculation that relates the total volume of a loaf of bread to its mass, and it presents the same evolution as the volume of bread. Thus, bread with the addition of Rp had higher values of the specific volume than the control, except for the 0.5% addition of Rp. Sheikholeslami et al. [85] reported a slight increase in the specific volume of bread obtained from wheat flour with the addition of 10% and 20% barley flour with a low proportional coating content for smaller mesh sizes, thus retaining more coating particles with the addition of guar gum. The highest value of the specific volume was obtained for sieve 40 with the addition of 1% guar gum ($2.90 \pm 0.20 \text{ cm}^3/\text{g}$) compared to the control ($2.70 \pm 0.17 \text{ cm}^3/\text{g}$), and was lower for sieve 50 with the addition of 20% barley flour with a low coating content, without the addition of guar gum ($2.10 \pm 0.17 \text{ cm}^3/\text{g}$). Instead, Hathorn et al. [78] obtained a specific volume reduction from $1.7 \text{ cm}^3/\text{g}$ to $1.4 \text{ cm}^3/\text{g}$ when adding 50% to 65% sweet potato flour.

In other studies, higher specific bread volumes were reported, for example, $3.3\text{--}4.0 \text{ cm}^3/\text{g}$ for bread prepared with the addition of heat-treated maitake mushroom powder [86], and $3.4\text{--}4.4 \text{ cm}^3/\text{g}$ for wheat bread with added dextrins [87].

3.3.3. Bread Moisture and Acidity

A higher moisture retention in bread is economical and is also required to lengthen shelf life [88].

A higher moisture content was found in bread prepared from WF–Rp mixtures compared to the control ($41.81 \pm 0.40\%$). The differences were significant ($p < 0.05$). The increase in bread moisture was probably determined by the increase in the water absorption of WF–Rp mixtures due to the higher fibre content of Rp. However, the bread moisture of samples with an addition of 2.5% Rp and AA as an improver did not follow the increasing tendency, as they were situated between the moistures of the control and the sample with the addition of 0.5% Rp. This might be expected, as several factors not determined in this study could influence the moisture content of bread.

Similar results are reported in the literature. Toasted bread with a high fibre content was obtained by adding 10%, 20%, and 30% of fine or coarse bran that was dark or light in colour, and wheat germ. The bread had a higher moisture content than the bread obtained from unbleached wheat flour ($39.29 \pm 0.34\%$) for all types of bran. The increase in moisture was explained by the higher amounts of water used to prepare the dough for samples with bran fractions [88]. Sidhu et al. observed that moisture content was slightly higher for bread with increasing levels of bran addition (10–30%) [89]. Another study reported an increase in moisture with increased levels of polyols [88]. They found a higher moisture content in bread prepared after the incorporation of 4% sorbitol as compared to the control.

Bread acidity (Table 4) values increased for all breads compared to the control (2.0 acidity degrees), reaching 2.25 ± 0.07 acidity degrees for bread prepared with WF–Rp with the 2.5% Rp addition. The differences were not significant ($p > 0.05$) according to the ANOVA one-way statistical analysis. Ascorbic acid is consumed during kneading, and if it somehow remains in excess in the dough, it will be distorted when baked. Other components of Rp, such as the organic acids of rosehip composition, may be responsible for the values obtained for acidity. This issue will be followed in future research.

3.3.4. Bread Crumb Porosity and Elasticity

The breads obtained were characterized by high porosity values (Table 4). Higher porosity was found in bread prepared from WF–Rp mixtures compared to the control ($87.75 \pm 1.06\%$), except for the porosity of bread with an addition of 0.5% Rp ($87.50 \pm 0.71\%$), which was slightly lower. The porosity values increased by 1.0% and 1.5% with the addition of Rp, then slightly decreased following the same trend as the height and the volume of bread. The differences were significant ($p < 0.05$). Besides dough stabilization and

gluten network strengthening [26,27], ascorbic acid used in breadmaking contributed to obtaining bread with a larger amount of smaller and evenly distributed pores, a larger volume [28], and a better porosity. Therefore, the addition of Rp provided the dough with a certain amount of ascorbic acid, which determined the increase in bread height, volume, and porosity.

The elasticity of the bread crumb is its property to return to its original shape after the action of a pressing force, and it depends on the quality and quantity of gluten in the flour and the freshness of the product [5]. It was determined a few hours after cooling and is reported as an average of triplicates $\pm$ SD (Table 4). Bread crumb elasticity showed a slight decrease for all samples compared to the control ($93.3 \pm 0.58\%$), varying from $91.70 \pm 0.58\%$ (0.5% Rp) to $88.50 \pm 0.50\%$ (2.5% Rp) with significant differences ($p < 0.05$). The decrease of bread crumb elasticity with the increase in the Rp addition could be associated with the slight decrease of gluten content in WF–Rp mixtures, as was discussed before (Section 3.1, Table 1). The crumb elasticity of bread with the AA addition was lower ($92.30 \pm 0.58\%$) but close to the control as expected, since its gluten content was equal to that of the control bread.

4. Conclusions

The substitution of wheat flour with rosehip powder influenced the composition of mixture flours by decreasing the moisture, protein, and wet gluten content, increasing the ash, fibre, and carbohydrate content, and introducing vitamin C into mixture flours at levels reflecting the amount of rosehip powder used. Furthermore, it determined changes in dough farinographic properties and bread physico-chemical characteristics. Compared to the control sample and flour where ascorbic acid was used as an improver, the water absorption of all mixture flours increased due to the increased fibre content. The dough development time, dough stability, and softening degree variations were significant, showing a combined influence of vitamin C provided by the rosehip powder, synthetic ascorbic acid, and the high fibre content in the mixture flours. Moreover, the rosehip powder addition positively influenced the farinographic quality number. The bread prepared from wheat flour with the rosehip powder addition showed a positive evolution of physico-chemical properties, such as a significant increase in height, volume, specific volume, moisture, acidity, and porosity, as well as a slight decrease in elasticity as compared to the control bread. These results indicate that rosehip powder could be used in breadmaking to replace synthetic ascorbic acid.

5. Patents

The results of the studies were firstly used in a Romanian patent application no. A/0069 of 19.09.2018: Pâine din făină de grâu cu adaos de pudră de măceșe și procedeu de obținere a acesteia (Bread with rosehip powder addition and process for obtaining the same). The abstract was published in *Buletinul Oficial de Proprietate Industrială, Secțiunea Brevete de Inventie (Official Bulletin of Industrial Property, Patent Section)* no. 3/2020, p. 16.

Author Contributions: Conceptualization, M.T. and N.V.; Methodology, N.V. and M.T.; Validation, N.V. and M.T.; Formal analysis, N.V.; Investigation, N.V. and M.T.; Writing—original draft preparation, N.V. and M.T.; Writing—review and editing, M.T.; Visualisation, N.V. and M.T.; Supervision, M.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding. Dunarea de Jos University of Galati funded the APC.

Acknowledgments: The authors thank Dizing SRL Brusturi, Neamt County, for technical support. This paper was supported by a grant offered by the Romanian Ministry of Research as Intermediate Body for the Competitiveness Operational Program 2014–2020, call POC/78/1/2/, project number SMIS2014 + 136213, acronym METROFOOD-RO.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Cauvain, S.P. *The Technology of Breadmaking*, 3rd ed.; Springer International Publishing: Cham, Switzerland, 2015; pp. 1–2, 27–29.
2. Scheuer, P.M.; Francisco, A.; Miranda, M.Z.; Ogilari, P.J.; Torres, G.; Limberger, V.; Montenegro, F.M.; Ruffi, C.R.; Biondi, S. Characterization of Brazilian wheat cultivars for specific technological applications. *Food Sci. Technol. Brazil* **2011**, *31*, 816–826. [CrossRef]
3. Kurek, M.A.; Wyrwisz, J.; Piwińska, M.; Wierzbicka, A. Influence of the wheat flour extraction degree in the quality of bread made with high proportions of β -glucan. *Food Sci. Technol. Brazil* **2015**, *35*, 273–278. [CrossRef]
4. Cauvain, S.P. Improving the texture of bread. In *Texture in Food*; Kilcast, D., Ed.; CRC Press: Boca Raton, FL, USA, 2004; Volume 2, pp. 432–450.
5. Bordei, D. *Tehnologia Modernă a Panificației (Modern Bakery Technology)*; AGIR Publishing House: Bucharest, Romania, 2004; pp. 86–87, 383–384, 517–518.
6. Haghighat-Kharazi, S.; Milani, J.M.; Kasaai, M.R.; Khajeh, K. Use of encapsulated maltogenic amylase in maltodextrins with different formulations in making gluten-free breads. *LWT* **2019**, *110*, 182–189. [CrossRef]
7. Zhang, L.; Li, Z.; Qiao, Y.; Zhang, Y.; Zheng, W.; Zhao, Y.; Huang, Y.; Cui, Z. Improvement of the quality and shelf life of wheat bread by a maltohexaose producing α -amylase. *J. Cereal Sci.* **2019**, *87*, 165–171. [CrossRef]
8. Jones, A.; Lamsa, M.; Frandsen, T.P.; Spendler, T.; Harris, P.; Sloma, A.; Xu, F.; Nielsen, J.B.; Cherry, J.R. Directed evolution of a maltogenic α -amylase from *Bacillus* sp. TS-25. *J. Biotechnol.* **2008**, *134*, 325–333. [CrossRef] [PubMed]
9. Woo, S.; Shin, Y.; Jeong, H.; Kim, J.; Ko, D.; Hong, J.S.; Choi, H.; Shim, J. Effects of maltogenic amylase from *Lactobacillus plantarum* on retrogradation of bread. *J. Cereal Sci.* **2020**, *93*, 102976. [CrossRef]
10. Goesaert, H.; Slade, L.; Levine, H. Amylases and bread firming—An integrated view. *J. Cereal Sci.* **2009**, *50*, 345–352. [CrossRef]
11. Rasiah, I.A.; Sutton, K.H.; Low, F.L.; Lin, H.M.; Gerrard, J.A. Crosslinking wheat dough proteins by glucose oxidase and the resulting effects on bread and croissants. *Food Chem.* **2005**, *89*, 325–332. [CrossRef]
12. Bhat, M.K. Cellulases and related enzymes in biotechnology. *Biotechnol. Adv.* **2000**, *18*, 355–383. [CrossRef]
13. Dahiya, S.; Bajaj, B.K.; Kumar, A.; Tiwari, S.K.; Singh, B. A review on biotechnological potential of multifarious enzymes in bread making. *Process. Biochem.* **2020**, *99*, 290–306. [CrossRef]
14. Al-Widyan, O.; Khataibeh, M.H.; Abu-Alruz, K. The use of xylanases from different microbial origin in bread baking and their effects on bread qualities. *J. Appl. Sci.* **2008**, *8*, 672–676. [CrossRef]
15. Ahmad, Z.; Butt, M.S.; Ahmed, A.; Riaz, M.; Sabir, S.M.; Farooq, U.; Rehman, F.U. Effect of *Aspergillus niger* xylanase on dough characteristics and bread quality attributes. *J. Food Sci. Technol.* **2012**, *51*, 2445–2453. [CrossRef] [PubMed]
16. Guo, Y.; Gao, Z.; Xu, J.; Chang, S.; Wu, B.; He, B. A family 30 glucurono-xylanase from *Bacillus subtilis* LC9: Expression, characterization and its application in Chinese bread making. *Int. J. Biol. Macromol.* **2018**, *117*, 377–384. [CrossRef] [PubMed]
17. Melis, S.; Meza Morales, W.R.; Delcour, J.A. Lipases in wheat flour bread making: Importance of an appropriate balance between wheat endogenous lipids and their enzymatically released hydrolysis products. *Food Chem.* **2019**, *298*, 125002. [CrossRef] [PubMed]
18. Boute, T.; Skogerson, L. Stearoyl-2-lactylates and oleoyl lactylates. In *Emulsifiers in Food Technology*, 2nd ed.; Norn, V., Ed.; Wiley-Blackwell: Chichester, UK, 2015; pp. 251–270.
19. Cottrell, T.; van Peij, J. Sorbitan esters and polysorbates. In *Emulsifiers in Food Technology*, 2nd ed.; Norn, V., Ed.; Wiley-Blackwell: Chichester, UK, 2015; pp. 271–275.
20. Gaupp, R.; Adams, W. Diacetyl Tartaric Acids of Monoglycerides (DATEM) and associated emulsifiers in bread making. In *Emulsifiers in Food Technology*, 2nd ed.; Norn, V., Ed.; Wiley-Blackwell: Chichester, UK, 2015; pp. 121–145.
21. Sahi, S.S. Ascorbic acid and redox agents in bakery systems. In *Bakery Products Science and Technology*, 2nd ed.; Zhou, W., Ed.; Wiley-Blackwell: Chichester, UK, 2014; pp. 183–197.
22. IARC Potassium Bromate (Group 2B). In International Agency for Research on Cancer (IARC)—Summaries & Evaluations. 1999, Volume 73, p. 481. Available online: <https://inchem.org/documents/iarc/vol73/73-17.html> (accessed on 21 November 2020).
23. Shanmugavel, V.; Santhi, K.K.; Kurup, A.H.; Kalakandan, S.; Anandharaj, A.; Rawson, A. Potassium bromate: Effects on bread components, health, environment and method of analysis: A review. *Food Chem.* **2020**, *311*, 125964. [CrossRef] [PubMed]
24. Bakerpedia. L-Cysteine. Available online: <https://bakerpedia.com/ingredients/l-cysteine/> (accessed on 17 November 2020).
25. Stoica, A.; Popescu, C.; Barascu, E.; Iordan, M. L-cysteine influence on the physical properties of bread from high extraction flours with normal gluten. *Ann. Food Sci. Technol.* **2010**, *11*, 6–10.
26. Wieser, H. The use of redox agents in breadmaking. In *Breadmaking: Improving Quality*, 2nd ed.; Cauvain, S.P., Ed.; Woodhead Publishing: Oxford, UK, 2012; pp. 447–469.
27. Belitz, H.-D.; Grosch, W.; Schieberle, P. *Food Chemistry*, 4th ed.; Springer: Berlin/Heidelberg, Germany, 2009; pp. 716–718.
28. Campbell, G.M.; Martin, P.J. Bread aeration and dough rheology: An introduction. In *Breadmaking: Improving Quality*, 2nd ed.; Woodhead Publishing: Oxford, UK, 2012; pp. 299–336.
29. Carr, A.C.; Vissers, M.C.M. Synthetic or food-derived vitamin C—Are they equally bioavailable? *Nutrients* **2013**, *5*, 4284–4304. [CrossRef]
30. Verbruggen, R. Food additives in the European Union. In *Food Additives*, 2nd ed.; Branen, A.L., Davidson, P.M., Salminen, S., Thorngate, J.H., III, Eds.; Marcel Dekker: New York, NY, USA, 2002; pp. 109–197.

31. Sahi, S.S. Applications of natural ingredients in baked goods. In *Natural Food Additives, Ingredients and Flavourings*; Baines, D., Seal, R., Eds.; Woodhead Publishing: Oxford, UK, 2012; pp. 318–332.
32. Ziegler, S.J.; Meier, B.; Sticher, O. Fast and Selective Assay of l-Ascorbic Acid in Rose Hips by RP-HPLC Coupled with Electrochemical and/or Spectrophotometric Detection. *Planta Med.* **1986**, *52*, 383–387. [[CrossRef](#)] [[PubMed](#)]
33. Czyzowska, A.; Klewicka, E.; Pogorzelski, E.; Nowak, A. Polyphenols, vitamin C and antioxidant activity in wines from *Rosa canina* L. and *Rosa rugosa* Thunb. *J. Food Compos. Anal.* **2014**, *39*, 62–68. [[CrossRef](#)]
34. Hua, L. Beauty-Maintaining Bread by Utilizing Roses and Chayote and Preparation Method. Thereof. Patent CN 105341087 A, 24 February 2016.
35. Kaiyun, L. Eye-Protecting Anti-Radiation Pineapple Bread and Preparation Method. Thereof. Patent CN 105341087 A, 24 February 2016.
36. Krolevets, A.A. Bread Production Method Comprising Nanostructured Extract of Dry. rosehip. Patent RU 2630250-C1, 6 September 2017.
37. AOAC. *Official Methods of Analysis of the Association of Official Analytical Chemists*, 15th ed.; Helrich, K., Ed.; Methods 920.183, 967.21, 983.23; Association of Official Analytical Chemists: Arlington, VA, USA, 1990.
38. AACC International. *Approved Methods of Analysis*, 11th ed.; Methods 46-11.02, 54-21; American Association of Cereal Chemists International: St. Paul, MN, USA, 2000.
39. ASRO. *Romanian Standards Catalog for Cereal and Milling Products Analysis*; SR 90:2007, SR 91:2007, SR EN ISO 20483:2014, SR EN ISO 21415-1:2007, SR EN ISO 21415-3:2007, SR EN ISO 2171:2010 and SR EN ISO 5530-1:2015; ASRO: Bucharest, Romania, 2008.
40. Ercisli, S. Chemical composition of fruits in some rose (*Rosa* spp.) species. *Food Chem.* **2007**, *104*, 1379–1384. [[CrossRef](#)]
41. Nojavan, S.; Khalilian, F.; Kiaie, F.M.; Rahimi, A.; Arabanian, A.; Chalavi, S. Extraction and quantitative determination of ascorbic acid during different maturity stages of *Rosa canina* L. fruit. *J. Food Compos. Anal.* **2008**, *21*, 300–305. [[CrossRef](#)]
42. Roman, I.; Stănilă, A.; Stănilă, S. Bioactive compounds and antioxidant activity of *Rosa canina* L. biotypes from spontaneous flora of Transylvania. *Chem. Cent. J.* **2013**, *7*, 73–82. [[CrossRef](#)]
43. Bhawe, A.; Schulzova, V.; Chmelarova, H.; Mrnka, L.; Hajslova, J. Assessment of rosehips based on the content of their biologically active compounds. *J. Food Drug Anal.* **2017**, *25*, 681–690. [[CrossRef](#)]
44. Banu, I.; Stoenescu, G.; Ionescu, V.S.; Aprodu, I. Effect of the addition of wheat bran stream on dough rheology and bread quality. *Ann. Univ. Dunarea Jos Galati Fascicle VI Food Technol.* **2012**, *36*, 39–52.
45. Al-Attabi, Z.H.; Merghani, T.M.; Ali, A.; Rahman, M.S. Effect of barley flour addition on the physico-chemical properties of dough and structure of bread. *J. Cereal Sci.* **2017**, *75*, 61–68. [[CrossRef](#)]
46. Koletta, P.; Irakli, M.; Papageorgiou, M.; Skendi, A. Physicochemical and technological properties of highly enriched wheat breads with wholegrain non wheat flours. *J. Cereal Sci.* **2014**, *60*, 561–568. [[CrossRef](#)]
47. Cvetković, B.R.; Filipčev, B.V.; Bodroža-Solarov, M.I.; Bardić, Ž.M.; Sakač, M.B. Chemical composition of dried fruits as a value added ingredient in bakery product. *Food Proc. Qual. Saf.* **2009**, *36*, 15–19.
48. Van Hung, P.; Maeda, T.; Morita, N. Dough and bread qualities of flours with whole waxy wheat flour substitution. *Food Res. Int.* **2007**, *40*, 273–279. [[CrossRef](#)]
49. Dall'Asta, C.; Cirlini, M.; Morini, E.; Rinaldi, M.; Ganino, T.; Chiavaro, E. Effect of chestnut flour supplementation on physico-chemical properties and volatiles in bread making. *LWT* **2013**, *53*, 233–239. [[CrossRef](#)]
50. Sun, R.; Zhang, Z.; Hu, X.; Xing, Q.; Zhuo, W. Effect of wheat germ flour addition on wheat flour, dough and Chinese steamed bread properties. *J. Cereal Sci.* **2015**, *64*, 153–158. [[CrossRef](#)]
51. Pınarlı, İ.; İbanoğlu, Ş.; Öner, M.D. Effect of storage on the selected properties of macaroni enriched with wheat germ. *J. Food Eng.* **2004**, *64*, 249–256. [[CrossRef](#)]
52. Arshad, M.U.; Anjum, F.M.; Zahoor, T. Nutritional assessment of cookies supplemented with defatted wheat germ. *Food Chem.* **2007**, *102*, 123–128. [[CrossRef](#)]
53. Mirsaedghazi, H.; Emam-Djomeh, Z.; Mousavi, S.M.A. Rheometric measurement of dough rheological characteristics and factors affecting it. *Int. J. Agric. Biol.* **2008**, *10*, 112–119.
54. Mohammed, M.I.O.; Mustafa, A.I.; Osman, G.A.M. Evaluation of wheat breads supplements with Teff (*Eragrostis tef* ZUCC. Trotter) grain flour. *Aust. J. Crop. Sci.* **2009**, *3*, 207–212.
55. Amjid, M.R.; Shehzad, A.; Hussain, S.; Shabbir, M.A.; Khan, M.R.; Shoaib, M. A comprehensive review on wheat flour dough rheology. *Pak. J. Food Sci.* **2013**, *23*, 105–123.
56. Berton, B.; Scher, J.I.; Villieras, F.D.R.; Hardy, J.I. Measurement of hydration capacity of wheat flour: Influence of composition and physical characteristics. *Powder Technol.* **2002**, *128*, 326–331. [[CrossRef](#)]
57. Coțovanu, I.; Mironeasa, S. Buckwheat seeds: Impact of milling fractions and addition level on wheat bread dough rheology. *Appl. Sci.* **2021**, *11*, 1731. [[CrossRef](#)]
58. Michel, S.; Löschenberger, F.; Ametz, C.; Pachler, B.; Sperry, E.; Bürstmayr, H. Combining grain yield, protein content and protein quality by multi-trait genomic selection in bread wheat. *Theor. Appl. Genet.* **2019**, *132*, 2767–2780. [[CrossRef](#)] [[PubMed](#)]
59. Paraskevopoulou, A.; Provatidou, E.; Tsotsiou, D.; Kiosseoglou, V. Dough rheology and baking performance of wheat flour-lupin protein isolate blends. *Food Res. Int.* **2010**, *43*, 1009–1016. [[CrossRef](#)]
60. Hefnawy, T.M.H.; El-Shourbagy, G.A.; Ramadan, M.F. Impact of adding chickpea (*Cicer arietinum* L.) flour to wheat flour on the rheological properties of toast bread. *Int. Food Res. J.* **2012**, *19*, 521–525.
61. Mohammed, I.; Ahmeda, A.R.; Senge, B. Dough rheology and bread quality of wheat-chickpea flour blends. *Ind. Crops Prod.* **2012**, *36*, 196–202. [[CrossRef](#)]

62. Gómez, M.; Ronda, F.; Blanco, C.; Caballero, P.; Apesteguia, A. Effect of dietary fibre on dough rheology and bread quality. *Eur. Food Res. Technol.* **2003**, *216*, 51–56. [\[CrossRef\]](#)
63. Lauková, M.; Kohajdová, Z.; Karovičová, J. Effect of hydrated apple powder on dough rheology and cookies quality. *Potravin. Slovak J. Food Sci.* **2016**, *10*, 506–511. [\[CrossRef\]](#)
64. Kohajdová, Z.; Karovičová, J.; Jurasová, M. Influence of carrot pomace powder on the rheological characteristics of wheat flour dough and on wheat rolls quality. *Acta Sci. Pol. Technol. Aliment.* **2012**, *11*, 381–387.
65. Ajila, C.M.; Leelavathi, K.U.J.S.; Rao, U.P. Improvement of dietary fiber content and antioxidant properties in soft dough biscuits with the incorporation of mango peel powder. *J. Cereal Sci.* **2008**, *48*, 319–326. [\[CrossRef\]](#)
66. Sudha, M.L.; Baskaran, V.; Leelavathi, K. Apple pomace as a source of dietary fiber and polyphenols and its effect on the rheological characteristics and cake making. *Food Chem.* **2007**, *104*, 686–692. [\[CrossRef\]](#)
67. Kohajdová, Z.; Karovičová, J.; Magala, M.; Kuchtová, V. Effect of apple pomace powder addition on farinographic properties of wheat dough and biscuits quality. *Chem. Zvesti* **2014**, *68*, 1059–1065. [\[CrossRef\]](#)
68. Kučerová, J.; Šottníková, V.; Nemodová, Š. Influence of dietary fibre addition on the rheological and sensory properties of dough and bakery products. *Czech. J. Food Sci.* **2013**, *31*, 340–346. [\[CrossRef\]](#)
69. Nikolić, N.; Saka, M.; Mastilovi, J. Effect of buckwheat flour addition to wheat flour on acylglycerols and fatty acids composition and rheology properties. *LWT-Food Sci. Technol.* **2011**, *44*, 650–655. [\[CrossRef\]](#)
70. Fu, L.; Tian, J.-C.; Sun, C.-L.; Li, C. RVA and farinograph properties study on blends of resistant starch and wheat flour. *Agric. Sci. China* **2008**, *7*, 812–822. [\[CrossRef\]](#)
71. Nassar, A.G.; Abdel-Hamied, A.A.; El-Naggar, E.A. Effect of citrus by-products flour incorporation on chemical, rheological and organoleptic characteristics of biscuits. *World J. Agric. Sci.* **2008**, *4*, 612–616.
72. Kohajdová, Z.; Karovičová, J.; Jurasová, M.; Kukurová, K. Effect of the addition of commercial apple fibre powder on the baking and sensory properties of cookies. *Acta Chim. Slov.* **2011**, *4*, 88–97.
73. Rosell, C.M.; Santos, E.; Penella, J.M.S.; Haros, M. Wholemeal wheat bread: A comparison of different breadmaking processes and fungal phytase addition. *J. Cereal Sci.* **2009**, *50*, 272–277. [\[CrossRef\]](#)
74. Liu, X.-L.; Mu, T.-H.; Sun, H.-N.; Zhang, M.; Chen, J.-W. Influence of potato flour on dough rheological properties and quality of steamed bread. *J. Integr. Agric.* **2016**, *15*, 2666–2676. [\[CrossRef\]](#)
75. Anil, M. Using of hazelnut testa as a source of dietary fiber in breadmaking. *J. Food Eng.* **2007**, *80*, 61–67. [\[CrossRef\]](#)
76. Stojceska, V.; Ainsworth, P. The effect of different enzymes on the quality of high-fibre enriched brewer's spent grain breads. *Food Chem.* **2008**, *110*, 865–872. [\[CrossRef\]](#) [\[PubMed\]](#)
77. Bchir, B.; Rabetafika, H.N.; Paquot, M.; Blecker, C. Effect of pear, apple and date fibres from cooked fruit by-products on dough performance and bread quality. *Food Bioproc. Technol.* **2014**, *7*, 1114–1127. [\[CrossRef\]](#)
78. Hathorn, C.S.; Biswas, M.A.; Gichuhi, P.N.; Bovell-Benjamin, A.C. Comparison of chemical, physical, micro-structural, and microbial properties of breads supplemented with sweet potato flour and high-gluten dough enhancers. *LWT* **2008**, *41*, 803–815. [\[CrossRef\]](#)
79. Tronsmo, K.M.; Faergestad, E.M.; Schofield, J.D.; Magnus, S. Wheat protein quality in relation to baking performance evaluated by the Chorleywood bread process and a hearth bread baking test. *J. Cereal Sci.* **2003**, *38*, 205–215. [\[CrossRef\]](#)
80. Gallagher, E.; Kunkel, A.; Gormley, T.R.; Arendt, E.K. The effect of dairy and rice powder addition on loaf and crumb characteristics, and on shelf life (intermediate and long-term) of gluten-free breads stored in a modified atmosphere. *Eur. Food Res. Technol.* **2003**, *218*, 44–48. [\[CrossRef\]](#)
81. Osuna, M.B.; Romero, C.A.; Romero, A.M.; Judis, M.A.; Bertola, N.C. Proximal composition, sensorial properties and effect of ascorbic acid and α -tocopherol on oxidative stability of bread made with whole flours and vegetable oils. *LWT* **2018**, *98*, 54–61. [\[CrossRef\]](#)
82. Hallén, E.; İbanoğlu, S.; Ainsworth, P. Effect of fermented/germinated cowpea flour addition on the rheological and baking properties of wheat flour. *J. Food Eng.* **2004**, *63*, 177–184. [\[CrossRef\]](#)
83. McWaters, K.H.; Phillips, R.D.; Walker, S.L.; McCullough, S.E.; Mensa-Wilmot, Y.; Saalia, F.K.; Hung, Y.-C.; Patterson, S.P. Baking performance and consumer acceptability of raw and extruded cowpea flour breads. *J. Food Qual.* **2004**, *27*, 337–351. [\[CrossRef\]](#)
84. Yamsaengsung, R.; Schoenlechner, R.; Berghofer, E. The effects of chickpea on the functional properties of white and whole wheat bread. *Int. J. Food Sci. Technol.* **2010**, *45*, 610–620. [\[CrossRef\]](#)
85. Sheikholeslami, Z.; Karimi, M.; Komeili, H.R.; Mahfouzi, M. A new mixed bread formula with improved physicochemical properties by using hull-less barley flour at the presence of guar gum and ascorbic acid. *LWT* **2018**, *93*, 628–633. [\[CrossRef\]](#)
86. Seguchi, M.; Morimoto, N.; Abe, M.; Yoshino, Y. Effect of Maitake (*Grifola frondosa*) mushroom powder on bread properties. *J. Food Sci.* **2001**, *66*, 261–264. [\[CrossRef\]](#)
87. Miyazaki, M.; Maeda, T.; Morita, N. Effect of various dextrin substitution for wheat flour on dough properties and bread qualities. *J. Food Res. Int.* **2004**, *37*, 59–65. [\[CrossRef\]](#)
88. Bhise, S.; Kaur, A. Baking quality, sensory properties and shelf life of breads with polyols. *J. Food Sci. Technol.* **2014**, *51*, 2054–2061. [\[CrossRef\]](#)
89. Sidhu, J.S.; Al-Hooti, S.N.; Al-Saqer, J.M. Effect of adding wheat bran and germ fractions on the chemical composition of high-fiber toast bread. *Food Chem.* **1999**, *67*, 365–371. [\[CrossRef\]](#)