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Cooking quality, color, and texture profile analysis of a quinoa and lentil pasta

Análise de qualidade de cozimento, cor e perfil de textura de uma pasta de quinoa e lentilha

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ABSTRACT

Quinoa (*Chenopodium quinoa* willd) and lentils (*Lens culinaris*) are ingredients used to enrich or substitute gluten in pasta manufacture due to their high nutritional content. The objective of this work was to develop quinoa noodles with lentils that have similar or superior attributes compared to the product with gluten. Therefore, we evaluated the cooking properties (cooking quality, hydration, rheology), color, and texture profile of noodles developed with different concentrations (10%, 20%, and 30%) of lentil flour (LF) in comparison to commercial wheat pasta (control). ANOVA comparisons were performed on cooking and texture profile attributes, with the best treatment being the one with values that did not significantly differ from the control sample (T0). Thus, T3 (70% quinoa grits and 30% LF) is the formulation that presents better and/or similar attributes to those of the control sample.

Index terms: Quinoa: treatment; control sample.

RESUMO

Quinoa (*Chenopodium quinoa* willd) e lentilhas (*Lens culinaris*) são ingredientes utilizados para enriquecer ou substituir o glúten em massas devido ao seu alto conteúdo nutricional. O objetivo deste trabalho foi desenvolver um macarrão de quinoa com lentilha com atributos semelhantes ou superiores ao produto com glúten. Para tanto, realizamos análise proximal e avaliamos as propriedades de cozimento (qualidade de cozimento, hidratação e reología), perfil de cor e textura de massas desenvolvidas com diferentes concentrações (10%, 20% e 30%) de farinha de lentilha (LF). Comparações de ANOVA foram realizadas nos atributos de cozimento e perfil de textura, sendo o melhor tratamento aquele com valores que não diferiram significativamente da amostra controle (T0). Assim, T3 é a formulação que apresenta atributos melhores e/ou semelhantes aos da amostra controle.

Termos para indexação: Quinoa: tratamento; amostra controle.

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Introduction

Global wheat production has increased steadily in recent years, but some factors could threaten its growth, such as climate change, pests, and diseases. Therefore, it is important to look for alternatives to replace wheat in the preparation of pasta. Some potential substitutes are quinoa and lentils, which are good sources of proteins, carbohydrates, fiber, and vitamins, have excellent functional and rheological properties, and are relatively inexpensive and accessible to consumers (FAO, 2011).

Quinoa flakes are made from quinoa grains through a pre-cooking and rolling process. Quinoa flakes and legume flours (e.g., lentil) are used as additional ingredients or partial replacements for wheat flour in the preparation of noodles, as their addition increases the protein content and also provides a unique flavor and texture (Burgos et al., 2019). However, the gluten protein fraction in wheat flour (that provides a smooth surface and attractive and malleable appearance) makes it difficult to eliminate gluten from pasta dough without the use of gums and proteins. Not to mention that the characteristics and physical properties differ from gluten-containing products (Giménez et al., 2016).

As most gluten-free products are generally made from refined flour of low nutrient content and considered inferior products, it is important to evaluate the physical and textural properties of the products used in pasta production (Giuberti et al., 2015). This is imperative for developing new products with similar or better physical and nutritional properties than the original product.

Various studies have explored the potential of quinoa and legumes in the preparation of gluten-free pasta. Different levels of quinoa flour (up to 30%) led to increased protein and fiber contents but with a negative impact on texture and color (Demir & Bilgiçli, 2021). Pasta based on chickpea or lentil flour showed good cooking and texture properties, but a slight legume flavor (Bayomy & Alamri, 2022). Extruded quinoa flour, potato starch, and tara gum negatively affected the firmness and cooking quality of the pasta which were overcome by increasing the concentration of lupine flour to 30% and using pea protein, especially without tara gum (Linares-García et al., 2019).

The objective of this work was to develop quinoa noodles with lentils that have similar or superior attributes to the gluten product, without the need to add wheat flour, gums, or binding agents. The gluten-free noodles were compared with commercial wheat pasta (control sample) in terms of physical and nutritional properties. This work represents a step forward towards the development of healthier and more sustainable foods.

Material and Methods

Raw material

Quinoa grits (QG) and lentil flour (LF) were acquired from the Naturkost company. The quinoa flakes belong to the Juli blanca variety from Cabana (Puno-Peru), the salt, the table water, and the noodles used as a control sample (T0) were purchased from a local market.

Pasta preparation

We prepared three formulations: Formulation T1: 90% QG -10% LF; formulation T2: 80% QG - 20% LF; and formulation T3: 70% QG - 30% LF. QG and LF (particle size 180-250 µm – AOAC 925.09) were mixed for 5 min. Subsequently, water (30%) with previously dissolved salt (4.8%) was added and kneaded for 10 min in a Nova Brand mixer (K50, Peru). Afterward, the dough was cold extruded and mixed again for another 10 min before the molding and cutting process. The dough obtained was subjected to a hot air dryer at 70°C for 4 h as recommended by Larrosa et al. (2016).

Pasta hydration

Pasta products were hydrated following the method reported by Shang et al. (2023) and Ulloa et al. (2016). Samples of 10 g of each formulation were immersed in 200 ml of distilled water at different temperatures (60 °C, 70 °C, and 80 °C). Every minute, portions of pasta were removed from the water, drained, blotted dry with an absorbent paper, weighed, and placed back into the beaker. This process was repeated until the maximum cooking time was reached. The moisture content was calculated for each time interval using a mass balance considering the initial mass of the samples, the initial humidity, and the mass obtained after each time interval.

Noodle hydration curves were generated by plotting water absorption (in g water/g dry solids) versus elapsed time (min). The hydration curves were evaluated for each temperature tested using the Peleg model (Corzo, Ramírez, & Bracho, 2008):

$$M(t) = Mo + \frac{t}{K_1 + K_2 \ x \ t}$$

Where: M(t) moisture content (%) at time t (min); Mo Initial humidity (%); K_1 speed constant (min $\%^{-1}$); capacity constant K_2 ($\%^{-1}$)

Pasta cooking quality

Cooking tests were performed in triplicate for each formulation following the AACC 66-50 method (American Association of Cereal Chemists AACC, 2000). Samples (25 g of dry pasta) were immersed in 300 ml of distilled water at 86 °C. The optimal cooking time (OCT) was measured when the white core in the noodles disappeared. Water absorption (WA) was determined by weight difference before and after cooking and reported as g of water/100 g. Finally, cooking losses (CL) were evaluated for 25 ml of cooking water subjected to 105 °C until constant weight in an oven (9140A, Kert Lab China). The result was expressed as g of solids/100 g of sample (López-Mejía, & Morales, 2020).

Color

The color of raw and cooked pasta was measured using a portable colorimeter (WR - 10QC, Fru, China) containing a CIE L*a*b* color space. The L* measurement corresponds to the luminosity (0–100), while a* represents the red-green coordinates and b* measures the yellow-blue coordinates. Six measurements were taken for each sample. Differences in L*, a*, and b* were compared to the total color difference (ΔE*) (Tiga et al., 2021).

Rheological properties

Measurements of rheological properties were carried out at 25 °C with a rheometer (MCR 72, Anton Paar Inc., Austria), using 5 g of cooked sample of each formulation. An amplitude scan was carried out to determine the linear viscoelastic region at a constant frequency of 10 rad/s and a strain of 0.1% (Sofi et al., 2020).

Texture profile analysis (TPA)

The texture of the cooked pasta was determined using a dynamometer (34tTM, Instron, USA) with a 5 kN load cell equipped with compression plates (P/75). The speed before the test was 0.50 mm/s and the deformation was 75% (Martinez et al., 2007).

Proximal analysis

The proximal analysis of the formulated pasta (T1, T2, and T3) and the control sample consisted of the quantification of moisture (NTP 206.011:2018a), protein, fiber, fat (FAO), ash (NTP 206.012:2018b), and total carbohydrates that were determined by difference calculation from the results.

Design and statistical analysis

All determinations were performed in triplicate, except for the color test (n = 6), and the means and standard deviations were calculated. The results were analyzed by analysis of variance (ANOVA, $p < 0.05$) using the statistical program Statgraphics Centurion XVI (Statistical Graphics Corp., Herndon, VA).

Results and Discussion

Proximal analysis

Table 1 shows the nutritional composition of the formulations tested. Formulation T3 stood out for its high protein content (15.02%) and fat (1.67%) compared to the commercial sample (T0) and the other formulations in addition to having a lower amount of carbohydrates (73.25 %). Wójtowicz and Mościcki, (2014) obtained similar protein values by partially substituting lentil flour at 10% (12.23 g/100 g), 20% (13.79 g/100 g), 30% (14.87 g/100 g), and 40% (16.40 g/100 g). Gupta, Sharma and Reddy Surasani (2021) and Bouasla, Wójtowicz and Zidoune (2017) also reported similar protein values. Bayomy and Alamri, (2022) and Teterycz et al. (2020) reached nutritional values around 15.89 g/100 g (protein), 3.21 g/100 g (fat), and 4.58 g/100 g (fiber) in lentil and chickpea noodles. Noodles made with lentils and quinoa are an excellent source of protein because both legumes are high-quality ingredients in terms of protein intake. LF is recognized for containing a significant amount of proteins of plant origin and quinoa is one of the few plant species that contains essential amino acids (Torres, Lema González, & Galeano Loaiza, 2021b). By combining both ingredients it is possible to increase the protein content in the final product, which is favorable for people who suffer from gluten intolerance or celiac disease.

Pasta hydration

The hydration curve of the noodles shows a gradual increase in water absorption over time and temperature (Figure 1). Pasta hydration occurred in all temperatures tested. Noodles began to absorb water and the absorption rates accelerated, reaching a maximum point where the amount of water stabilized (Adachi et al., 2021). Heat helps break down food structures and facilitates water to enter the noodles. High temperatures accelerate the decomposition process of starches to be easily digestible (Ogawa, & Adachi, 2016) as observed at 70 °C and 80 °C with all treatments having greater water absorption in a short time.

Formulation T1 interacted with T0 (control) at 60 °C and 70 °C, whereas T3 only at 60 °C. Formulation T2 absorbed the least amount of water at the different temperatures.

Table 2 shows the effect of temperature on the hydration of quinoa and lentil pasta, as well as the values and constants obtained through the Peleg model. The water absorption capacity (K_2) exhibited a high initial rate of 1.073 g water/g ds (T1 at 60 °C) and 1.031 g water/g ds (T0 at 80 °C).

K_2 constant increased at a higher temperature in formulations T0 (control) and T3, while decreasing in formulations T1 and T2. Formulation T0 has gluten and the protein network while formulation T3 has the highest amount of protein of all the treatments, which enables them to trap water. As temperature increases, proteins and fibers denature, facilitating water diffusion (Mastromatteo et al., 2012).

Table 1: Nutritional composition of quinoa pasta with lentils.

	T0	T1	T2	T3
Carbohydrates (%)	78.04 ± 1.02[a]	74.45 ± 0.87[b]	73.32 ± 0.98[c]	73.25 ± 0.79[d]
Energy (Kcal/100 g)	362.28 ± 0.84[a]	358.77 ± 0.93[b]	358.84 ± 0.91[c]	368.11 ± 1.04[d]
Protein (%)	12.26 ± 0.92[a]	12.7 ± 0.87[a]	13.69 ± 0.95[a]	15.02 ± 0.77[b]
Fat (%)	0.12 ± 0.05[a]	1.13 ± 0.24[b]	1.2 ± 0.25[c]	1.67 ± 0.47[d]
Ash (%)	0.45 ± 0.36[a]	4.21 ± 0.82[b]	3.69 ± 0.98[c]	3.45 ± 0.57[d]
Moisture (%)	9.13 ± 0.87[a]	7.51 ± 0.46[b]	8.1 ± 0.96[a]	6.61 ± 0.77[c]
Crude fiber (%)	1.08 ± 0.55[a]	1.05 ± 0.32[a]	1.03 ± 0.53[a]	1± 0.21[a]

Data are means ± standard deviation (n = 3). Significant differences (ANOVA, $p < 0.05$) among treatments are indicated by letters. T0: control sample; T1: 90% QG -10% LF; T2: 80% QG - 20% LF; T3: 70% QG - 30% LF.

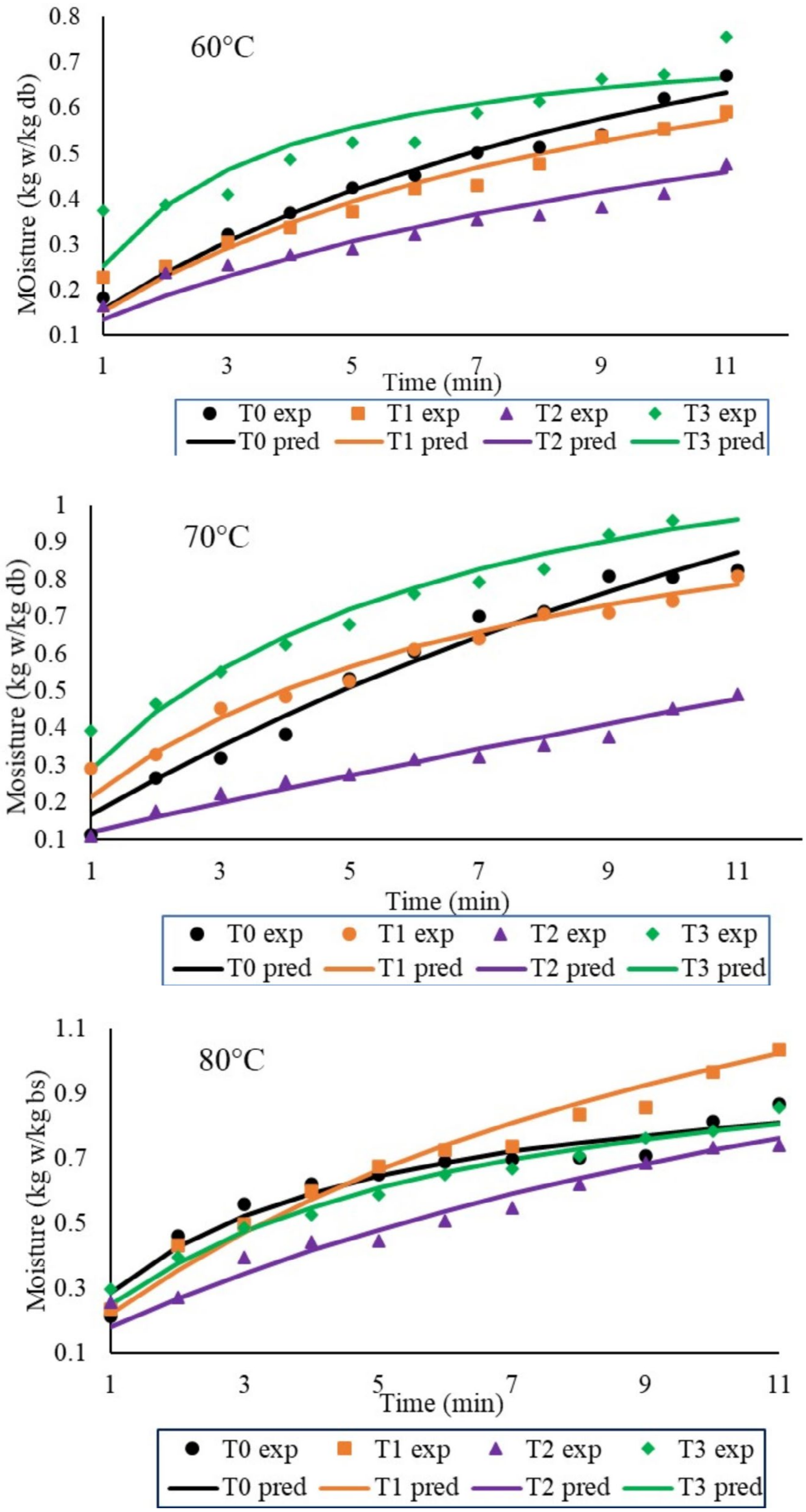


Figure 1: Paste hydration kinetics as a function of temperature. The lines represent data fitted with the Peleg model. T0: control sample; T1: 90% QG -10% LF; T2: 80% QG - 20% LF; T3: 70% QG - 30% LF; exp: experimental data; pred: predicted data.

Table 2: Water absorption properties of formulations under the effect of temperature, according to the Peleg model.

Formulation	Kinetic parameter	Temperature		
		60 °C	70 °C	80 °C
T0	K_1 (min g bs/g H_2O)	9.72 ± 0.13	9.20 ± 0.18	3.45 ± 0.21
	K_2 (g bs/g H_2O)	0.87 ± 0.28	0.40 ± 0.16	1.03 ± 0.18
	H_{pred} (g H_2O/g bs)	7.53 ± 0.52	8.89 ± 0.20	7.35 ± 0.33
	R^2	0.98	0.98	0.94
	t (min)	2.45 ± 0.33	5.76 ± 0.19	7.21 ± 0.13
T1	K_1 (min g bs/g H_2O)	9.53 ± 0.61	5.51 ± 0.64	5.68 ± 0.45
	K_2 (g bs/g H_2O)	1.07 ± 0.15	0.87 ± 0.81	0.52 ± 0.31
	H_{pred} (g H_2O/g bs)	6.77 ± 0.42	6.99 ± 0.12	7.76 ± 0.22
	R^2	0.96	0.97	0.96
	t (min)	7.56 ± 0.53	8.65 ± 0.28	6.04 ± 0.17
T2	K_1 (min g bs/g H_2O)	16.28 ± 0.29	24.61 ± 0.32	9.52 ± 0.25
	K_2 (g bs/g H_2O)	1.15 ± 0.40	0.27 ± 0.24	0.60 ± 0.31
	H_{pred} (g H_2O /g bs)	8.86 ± 0.16	11.62 ± 0.11	9.65 ± 0.20
	R^2	0.92	0.97	0.96
	t (min)	7.21 ± 0.32	6.92 ± 0.15	3.46 ± 0.24
T3	K_1 (min g bs/g H_2O)	0.19 ± 0.34	3.82 ± 0.22	4.47 ± 0.30
	K_2 (g bs/g H_2O)	0.09 ± 0.41	0.77 ± 0.37	0.94 ± 0.44
	H_{pred} (g H_2O/g bs)	11.38 ± 0.10	8.34 ± 0.08	7.34 ± 0.13
	R^2	0.89	0.96	0.98
	t (min)	3.96 ± 0.16	7.56 ± 0.28	7.21 ± 0.26

Data are means ± standard deviation (n = 3). T0: control sample; T1: 90% QG -10% LF; T2: 80% QG - 20% LF; T3: 70% QG - 30% LF), H_{pred}: predicted humidity.

Regarding the mass transfer rate, the higher the value of K_1, the greater the initial speed of water absorption. According to the value obtained from the Peleg model, formulation T2 had the highest water absorption rate in the initial stage at all three temperatures studied (16.28, 24.61, and 9.52 min g bs/g H_2O at 60 °C, 70 °C, and 80 °C, respectively). The Peleg model considers both the moisture content and the water absorption capacity of the food. Therefore, the specific combination of QG and LF in formulation T2 may be promoting a higher rate of water absorption compared to the other formulations.

Cunningham et al. (2007) demonstrated in dried penne pasta (10 mm diameter) that the Peleg constants K_1 and K_2 decreased with temperature, and observed a porous and homogeneous protein structure with few starch granules. Ogawa and Adachi (2017) obtained average estimated values of K_1, K_2, and H_{pred} for wheat pasta in the range of 20 °C to 90 °C of 1.21 kg-H_2O/kg m.s, and 7.42 × 10^{-4} 1/s respectively. The equilibrium moisture content is limited by starch gelatinization while the initial rate of hydration is regulated by the diffusion of water through the pores of the dough. This can decrease cooked pasta quality and moisture content, which affects mechanical properties and optimal rehydration time (Ogawa, & Adachi, 2014).

Cooking quality

Evaluating the cooking quality of the pasta involves considering the amount of solids released during cooking, the water absorption, and the swelling index (Torres et al., 2021a). The OCT for T0 (commercial sample) was higher (8.4 min) compared to formulations T1 (5.35 min), T2 (6.22 min), and T3 (7.13 min) (Table 3). WA was lower in T2, whereas the values of IH were close to the control (T0). CL increased in T2 and T3.

The optimal cooking time and swelling index are lower in the formulations with QG and LF than in the control sample because flours without gluten generally cook faster than wheat flour (Table 3). Gluten is a protein that helps the dough expand and stay fluffy during cooking. In the absence of gluten, the dough does not have the same structure and tends to fall apart. For example, in the work of Romero and Zhang (2019), noodles made with chickpea flour cooked in 5.5 min, while noodles made with wheat flour cooked in 10 min. In the work of Schoenlechner et al. (2010) and Zhao et al.

(2020), noodles made with quinoa and potato flour cooked in 3 and 4 min, while noodles made with wheat flour cooked in 9-10 min.

Feijoo et al. (2017) noted that the resistance to disintegration during cooking is directly affected by the complete substitution of wheat flour. In the case of gluten-free pasta, such as formulations T1, T2, and T3, starch polymers are less encapsulated, which can hinder the excessive swelling of starch granules and, therefore, the dispersion of components in the cooking water. CL are related to the disruption in the protein/starch matrix, which causes an uneven distribution of water inside the noodles.

Rheological properties

In the rheological testing of dough, the storage modulus (G') is used to measure the strength of the pasta, while the loss modulus (G'') is used to measure its elasticity (Motta Romero et al., 2017). The strength and elasticity of pasta are its ability to resist deformation and to return to its original shape after being deformed, respectively. Figure 2 shows that the storage modulus (G') is greater than the loss modulus (G'') (Figure 3), which indicates that all kinds of pasta are resistant to deformation and have a more elastic than viscous behavior with good bonding characteristics and dense internal structure (Sofi et al., 2020). Pastas with high moisture and protein content have a higher G' value. This behavior is commonly observed in elastic solids. Torres Vargas et al. (2021b) and Zhang et al. (2018) obtained similar results with doughs based on quinoa and other plant species (starch-gluten), respectively. A high storage modulus suggests an intense interaction between particles or a stable network-like structure (Burgos et al., 2019).

Texture profile

Only hardness (increased in T1 and T2) and fracture ability (increased in T2 and T3) differed in some formulations compared to the control, whereas the other parameters (cohesiveness, elasticity, chewiness, and gumminess) were unchanged (Table 4).

The hardness and chewiness of cooked pasta are determined by the presence of proteins linked to gliadins, while factors preventing the disintegration of pasta when cooked are glutenins and the low proportion of water-soluble proteins.

Bouasla, Wójtowicz and Zidoune (2017) report the hardness of hydrated pasta to be 0.44 N for rice pasta and 0.21 - 0.40 N for pasta enriched with legume flours. The same trends were observed by Wójtowicz and Mościcki (2014) for pre-cooked soft wheat pasta enriched with legume flours. The fiber fractions of legume flour can cause the formation of cracks or discontinuities within the pasta strand that weaken the pasta structure.

Table 3: Pasta cooking quality.

Variables	T0	T1	T2	T3
OCT (min)	8.40 ± 0.09ᵃ	5.35 ± 0.09ᵇ	6.22 ± 0.06ᵇ	7.13 ± 0.39ᵇ
WA (g/100 g)	80.103 ± 2.09ᵃ	76.77 ± 7.4ᵃ	73.64 ± 6.0ᵇ	82.93 ± 7.3ᵃ
CL (%)	1.35 ± 0.25ᵃ	0.97 ± 0.15ᵃ	1.02 ± 0.37ᵇ	1.26 ± 0.25ᵇ
IH (g w/g ps)	1.6 ± 0.04ᵃ	1.08 ± 0.06ᵃ	0.95 ± 0.07ᵃ	1.1 ± 0.18ᵃ

Data are means ± standard deviation (n = 3). Significant differences (ANOVA, $p < 0.05$) among treatments are indicated by letters. T0: control sample; T1: 90% QG - 10% LF; T2: 80% QG - 20% LF; T3: 70% QG - 30% LF;. OCT: optimal cooking time; WA: water absorption; CL: cooking losses; and IH: swelling index.

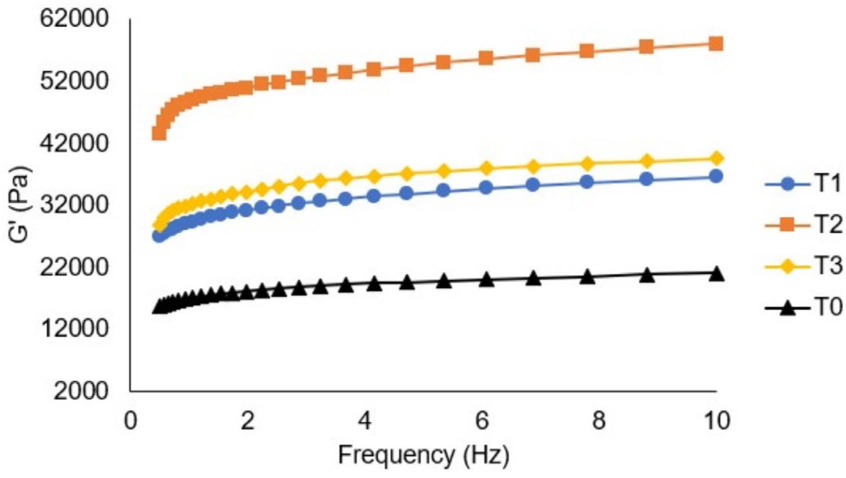


Figure 2: Storage module (G') of quinoa pasta with lentils.

Color

The elements that define the color of pasta are the ingredients that contain carotenoids, pigments that contribute to the yellow color, as well as the duration and temperature of the cooking process that can alter the Maillard reaction. Gluten-free flours tend to produce darker or paler pasta (Mastromatteo et al., 2012). Quinoa pasta with lentils naturally does not contain wheat flour or eggs, foods that contribute to the color, nor do they have the characteristic color of commercial pasta. According to the color variation (ΔE), the color difference is perceptible to the naked eye compared to the control sample (T0).

When examining the CIEL*a*b* coordinates obtained for the various formulations (Table 5 and Figure 4), the decrease in the values of L*, a*, and b* in the raw pasta is evident, in addition to the notable difference in values compared to T0. As the addition of LF increased, the values decreased in both raw and cooked pasta.

Petitot et al. (2010) obtained similar values of pasta color attributes. In pasta with peas and beans, a* values ranged between 5.0-21.5 and b* values between 7.8-20.3, data similar to ours (Marengo et al., 2018); Regarding luminosity values (L*), López-Mejía & Morales, (2020) obtained ranges from 64.02-67.85 in pasta enriched with pumpkin. Each value obtained in

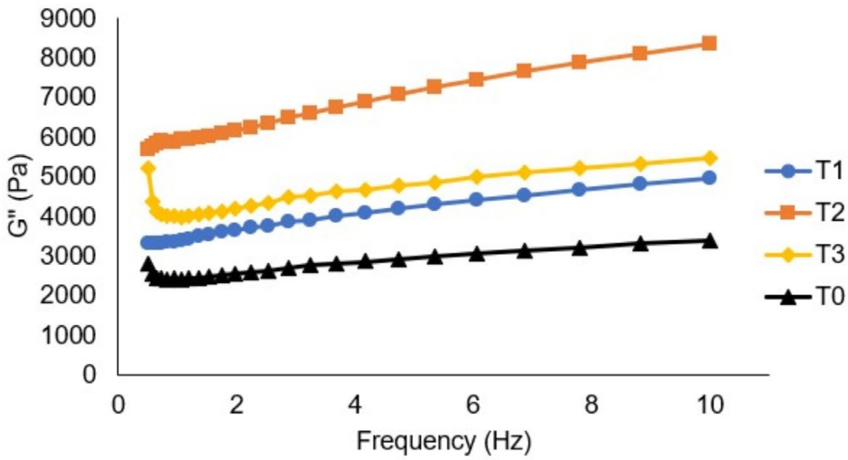


Figure 3: Loss modulus (G") of quinoa pasta with lentils.

Table 4: Texture profile of cooked pasta.

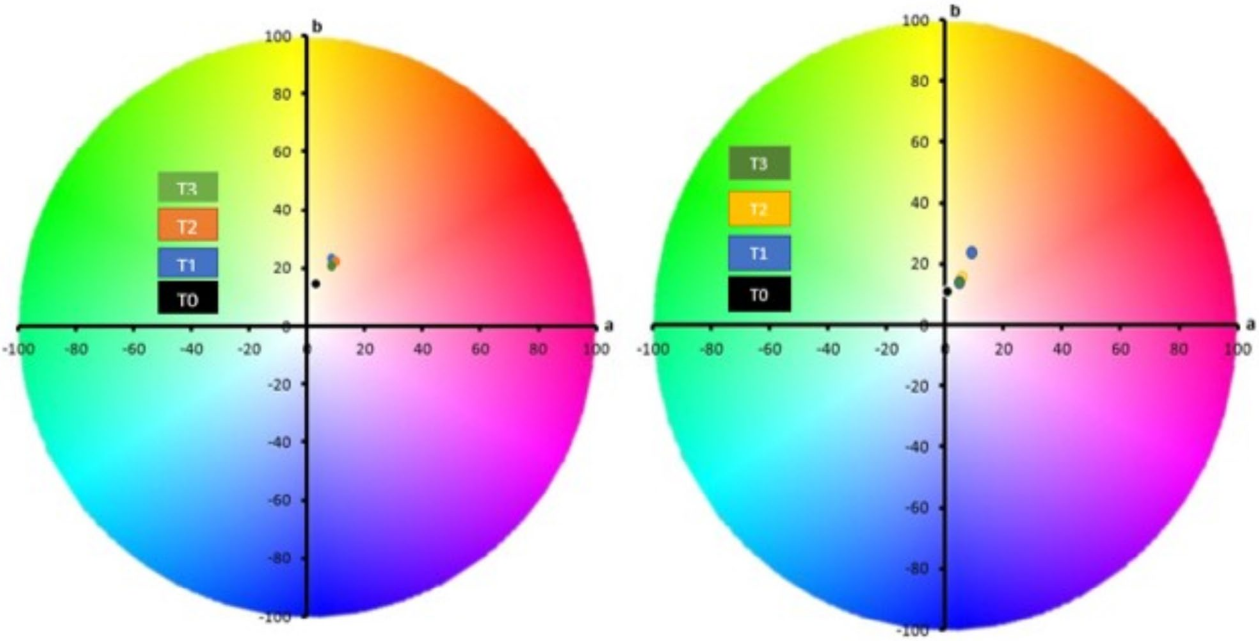
Form.	Hardness (N)	Cohesiveness	Elasticity	Chewiness (N)	Gumminess (N)	Fracture ability (N)
T0	0.51 ± 0.20[a]	0.52 ± 0.06[a]	0.99 ± 0.02[a]	0.26 ± 0.08[a]	0.26 ± 0.08[a]	0.51 ± 0.20[a]
T1	0.76 ± 0.11[b]	0.11 ± 0.06[a]	0.79 ± 0.37[a]	0.06 ± 0.02[a]	0.09 ± 0.05[a]	0.76 ± 0.11[a]
T2	1.28 ± 0.27[b]	0.06 ± 0.01[a]	1 ± 0.00[a]	0.08 ± 0.03[a]	0.08 ± 0.03[a]	1.24 ± 0.37[b]
T3	0.69 ± 0.13[a]	0.03 ± 0.03[a]	1 ± 0.00[a]	0.02 ± 0.03[a]	0.02 ± 0.03[a]	0.76 ± 0.04[b]

Data are means ± standard deviation (n = 3). Significant differences (ANOVA, $p < 0.05$) among treatments are indicated by letters. T0: control sample; T1: 90% QG -10% LF; T2: 80% QG - 20% LF; T3: 70% QG - 30% LF).

Table 5: Color attributes in raw and cooked pasta.

Form.	Raw Pasta				Cooked Pasta			
	L*	a*	b*	ΔE	L*	a*	b*	ΔE
T0	56.46 ± 0.87	3.29 ± 0.1	14.06 ± 0.3		64.46 ± 3.85	1.27 ± 0.19	10.25 ± 0.62	
T1	65.76 ± 2.33	9.31± 0.64	23.28 ± 1.16	14.41	64.18 ± 1.89	7.26 ± 0.88	23.28 ± 1.16	14.34
T2	64.22 ± 2.03	9.65 ± 0.37	22.88 ± 0.88	13.36	65.58 ± 1.32	5.68 ± 0.58	16.54 ± 1.16	7.76
T3	63.9 ± 2.66	8.61 ± 0.65	21.01 ± 0.76	11.49	63.15 ± 1.04	5.36 ± 0.35	15.2 ± 0.53	6.55

Data are means ± standard deviation (n = 6). T0: control sample control; T1: 90% QG -10% LF; T2: 80% QG - 20% LF; T3: 70% QG - 30% LF. L: luminosity, a: red-green coordinates, b: yellow-blue coordinates, ΔE: total color difference.



(a) Raw pasta (b) Cooked pasta

Figure 4: Location of the CIEL*a*b* scale on the raw and cooked pasta color discs.

the present work is between that obtained by the aforementioned authors. It should be noted that as long as foods with a high content of carotenoids or dyes are used, the pasta will have a pale color. Our formulations with quinoa and lentils do not contain this component in abundance, which is why the color obtained is pale yellow (Figure 4).

Conclusions

In this study, significant differences in variables between the developed formulations (T1,T2, and T3) and the control sample (T0) were evident. While all formulations adapted better to hydration temperatures than the control, T0 performed better in rheology tests. T3, despite having high protein (15%), showed the most similar cooking quality to T0. Color and texture analyses revealed significant differences from the control. Overall, T3 appears to offer the best balance of properties similar to the control.

Author Contribution

Conceptual Idea: Mayta-Pinto, E.; Methodology design: Mayta-Pinto, E.; Vargas-Huamán, E.; Pinto-Hurtado, V.; Data collection: Vargas-Huamán, E.; Pinto-Hurtado, V.; Data analysis and interpretation: Vargas-Huamán, E.; Pinto-Hurtado, V.; Mayta-Pinto, E.; Prieto, J.M.; and Writing and editing: Vargas-Huamán, E.; Mayta-Pinto, E.; Pinto-Hurtado, V.

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