XV INTERNATIONAL LUPIN CONFERENCE 2019

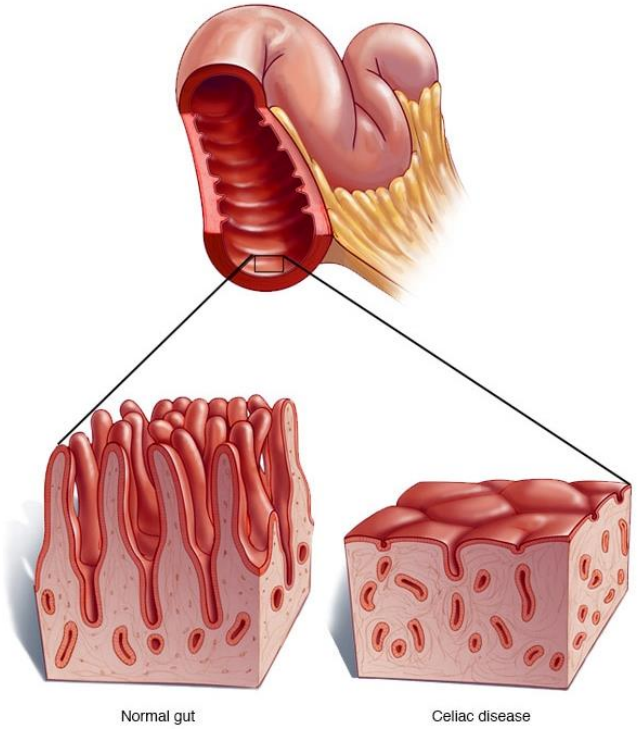
Development of gluten-free bread with quinoa (*Chenopodium quinoa* Willd.) and tarwi (*Lupinus mutabilis* S.) flours

Julio Vidaurre-Ruiz[1], Genny Luna-Mercado[1], Regine Schonlechner[2], Ritva Repo-Carrasco-Valencia[1]

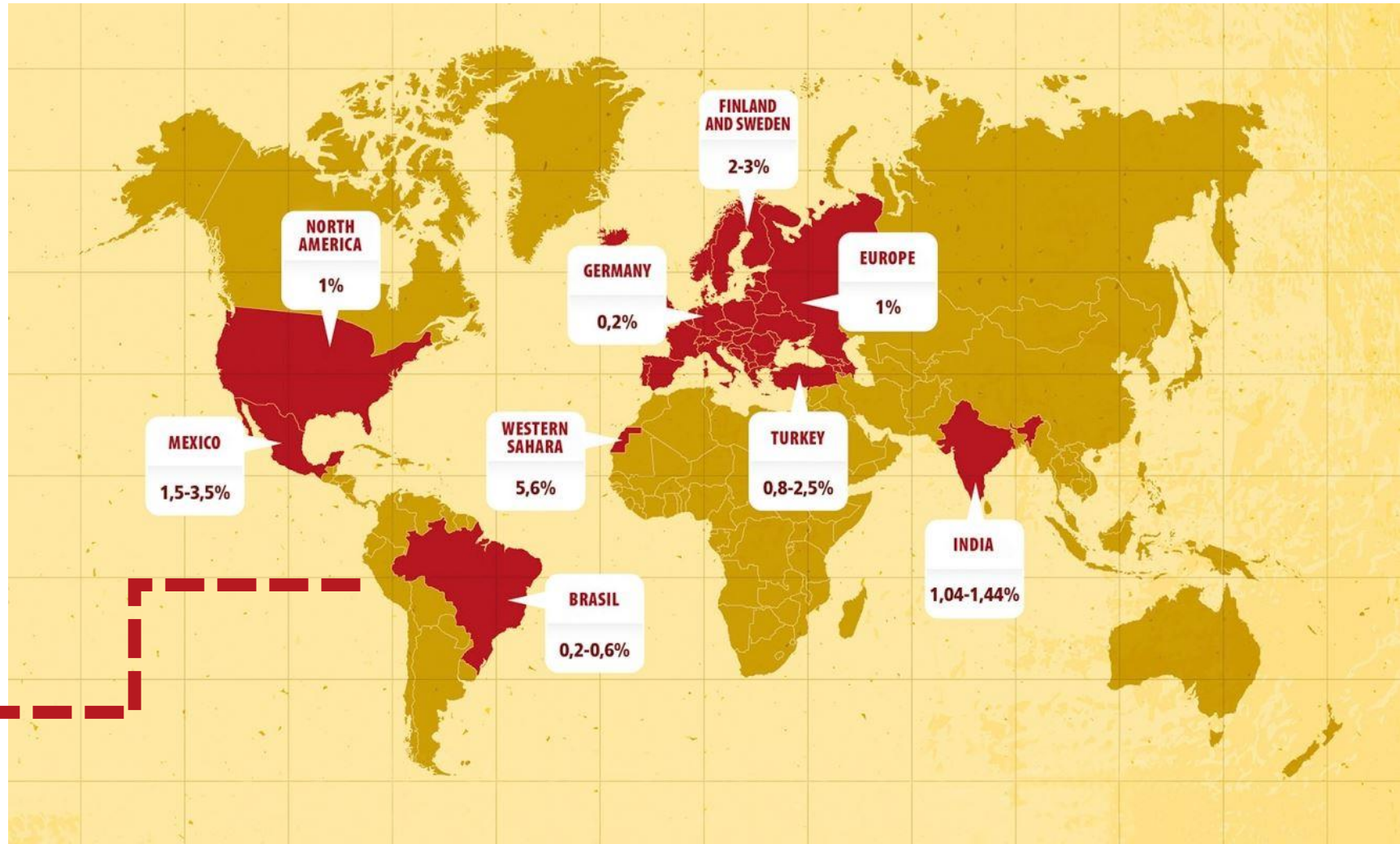
[1]Universidad Nacional Agraria La Molina, Perú

[2]University of Natural Resources and Life Sciences, Austria

Introduction



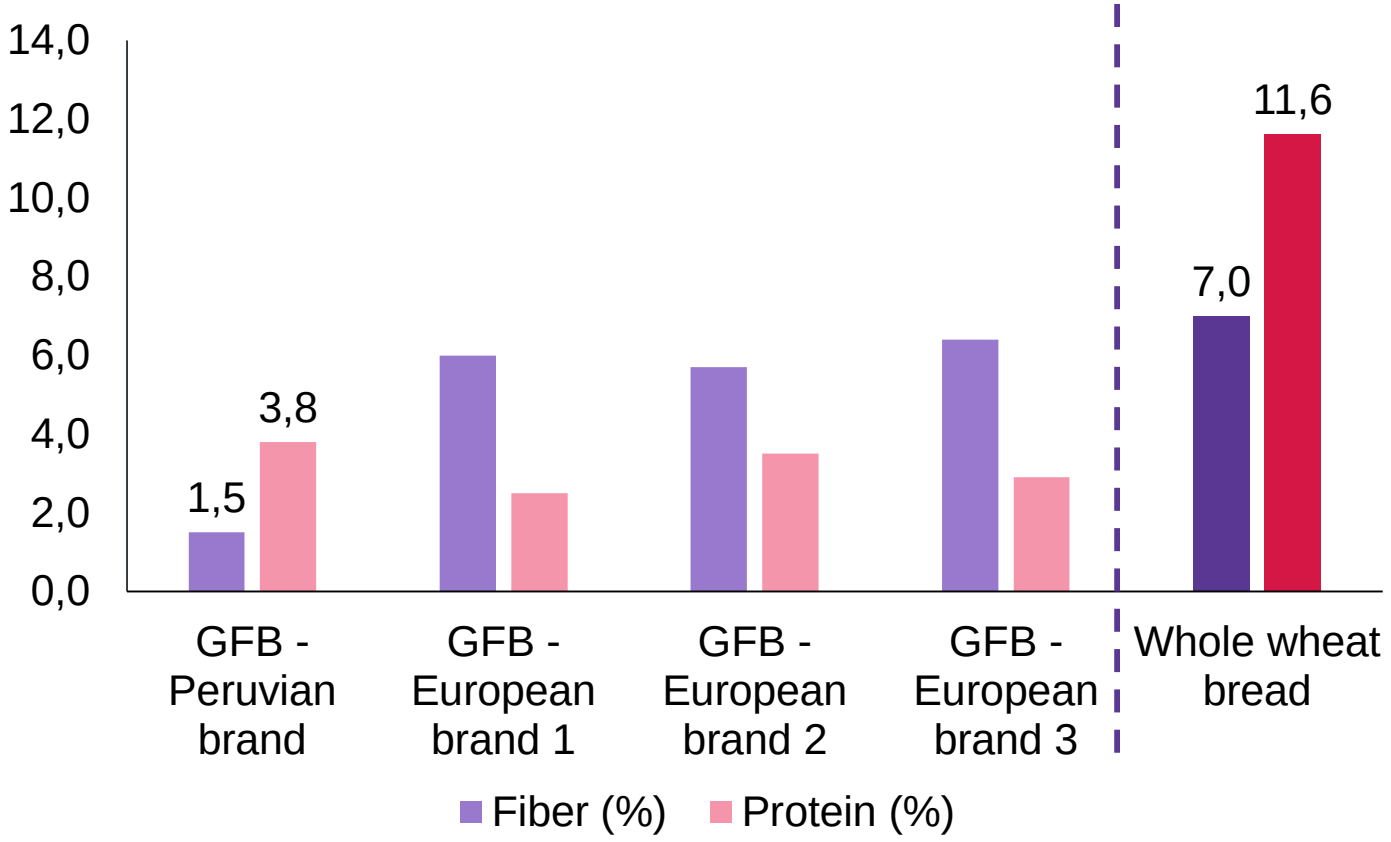
Celiac disease prevalence



ASOCIACIÓN DE CELIACOS DEL PERÚ

Introduction

Protein and fiber content in commercials brands of Gluten Free Bread (GFB)



The gluten-free breads available in the market are generally made from starches and rice flour, showing poor quality characteristics in volume and texture, as well as a poor nutritional profile.

Objectives

The aim of this research was to develop a gluten-free bread containing whole-grain quinoa and tarwi flours as primary components.

Red quinoa flour
(Pasankalla)

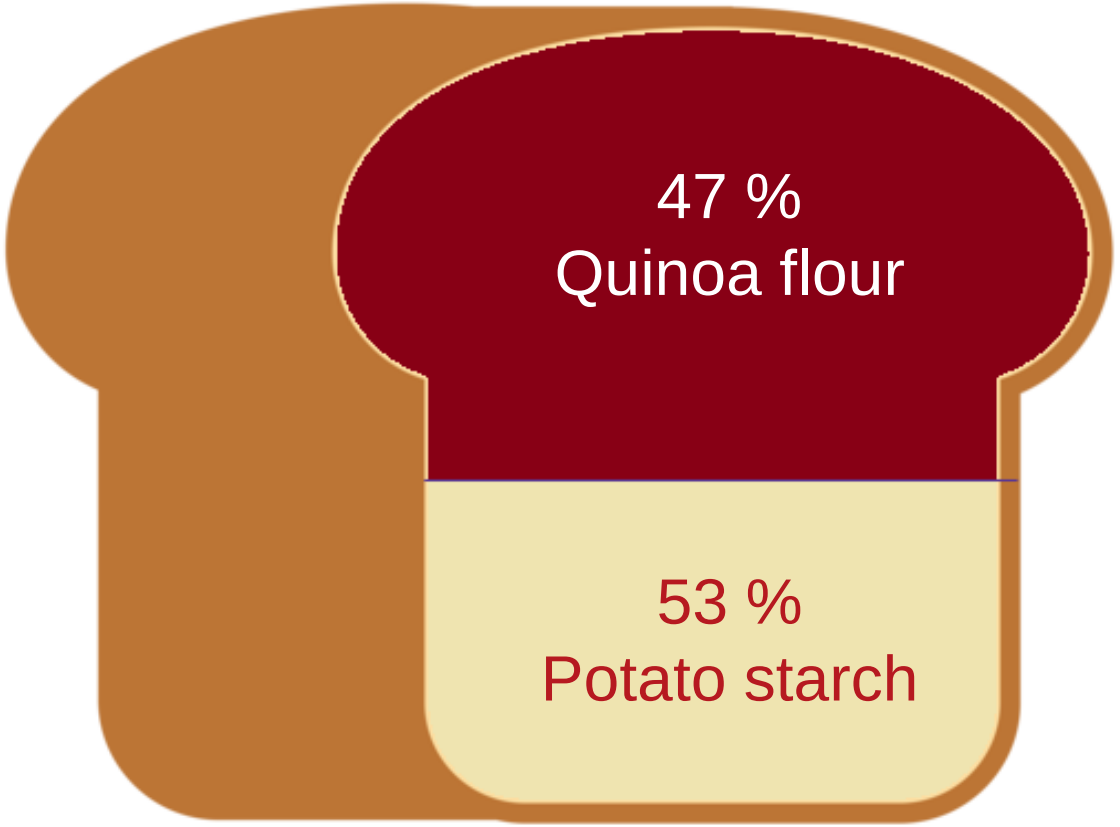
14,4 % Protein
5,8 % Fat
7,2 % Fiber

Tarwi flour
(Blanco de yunguyo)

52,9 % Protein
21,6 % Fat
8,8 % Fiber

These flours are promising raw materials for the development of gluten-free products, due to the content of natural emulsifiers and good nutritional profile.

Experimental procedure



Formulation developed in a previous work

75% of water, 0.5% mixture of xanthan gum and tara gum (ratio 1: 1) , 6% vegetable oil, 3% sugar, 2% salt and 3% yeast.

Central Composite Rotatable Design (CCRD) was used to determine the optimum level of:

10 % ≤ tarwi flour ≤ 30 %
75 % ≤ water ≤ 160 %

Imitate

Dough textural properties

Experimental procedure

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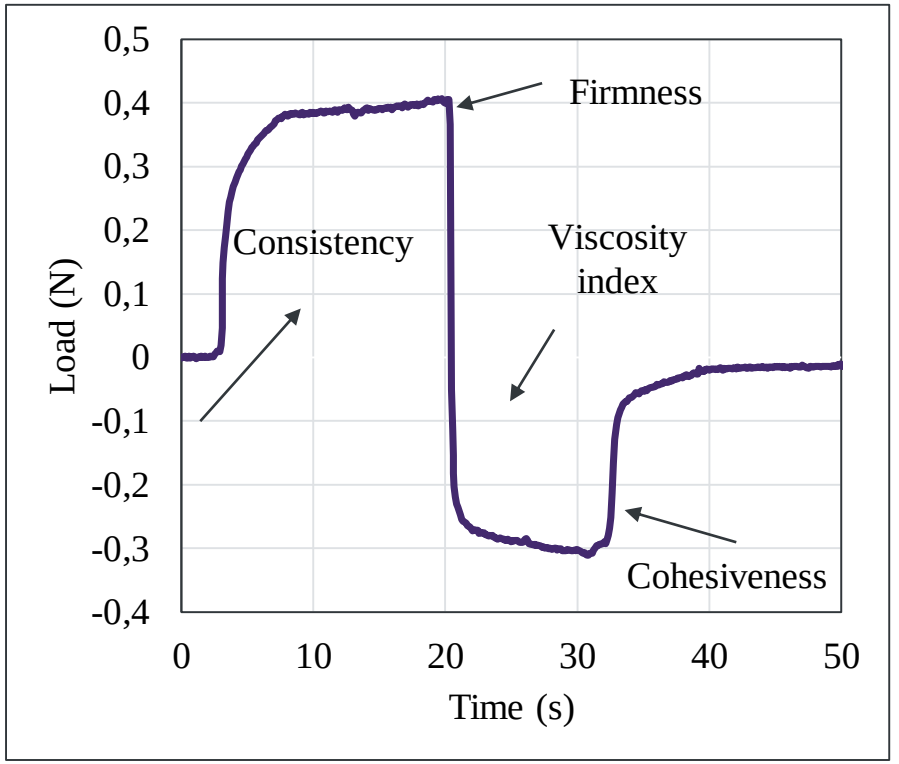
Design Properties

Std	Run	Factor 1 A:Harina de tarwi %	Factor 2 B:Agua %
1	13	10	75
2	9	30	75
3	10	10	160
4	3	30	160
5	4	5.85786	117.5
6	12	34.1421	117.5
7	8	20	57.3959
8	7	20	177.604
9	11	20	117.5
10	1	20	117.5
11	2	20	117.5
12	5	20	117.5
13	6	20	117.5



Design-Expert® software ➡ Back Extrusion accessory of INSTRON® texturometer ➡ Dough textural properties

Results

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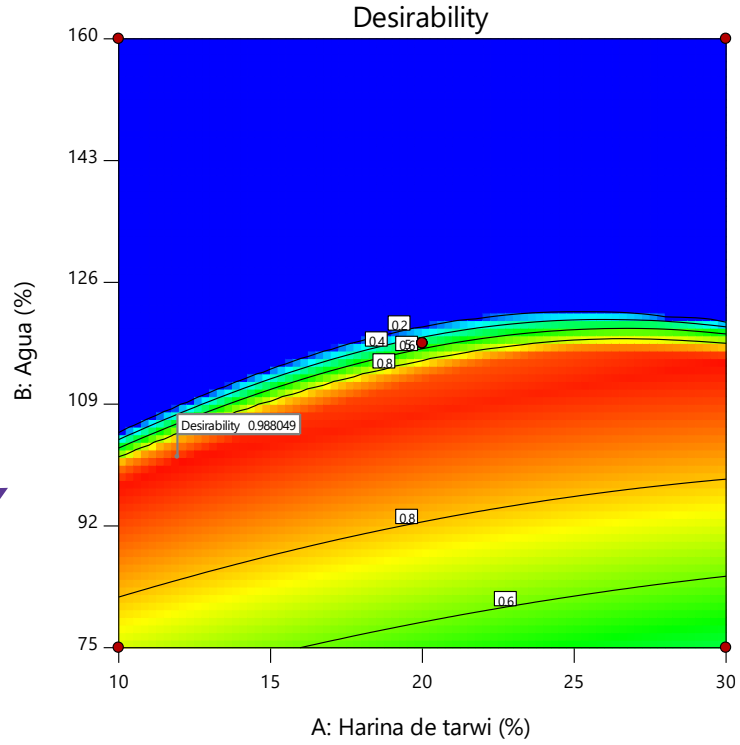
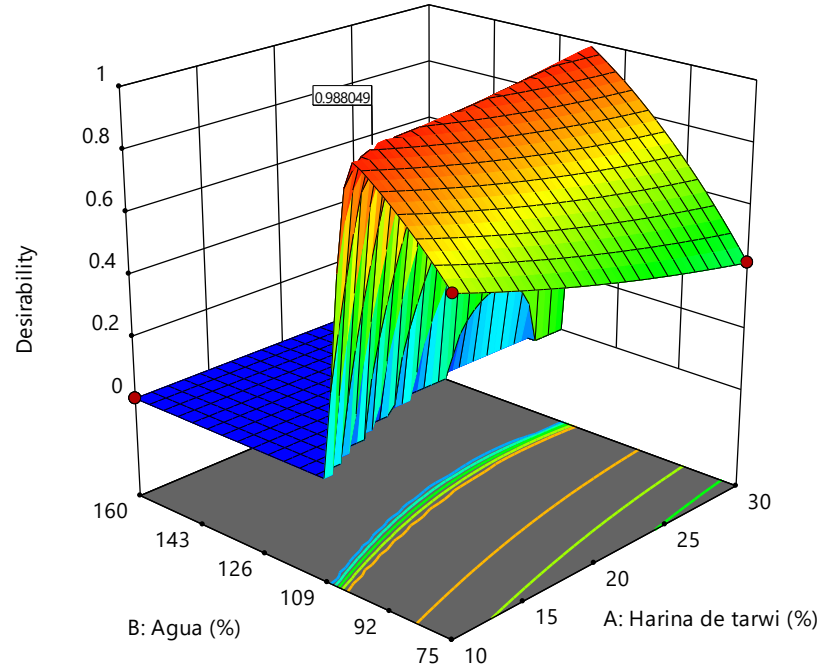
	Std	Run	Factor 1 A:Harin... %	Factor 2 B:Agua %	Response 1 Firmeza N	Response 2 Consistencia N.s	Response 3 Cohesividad N	Response 4 Índice de visc... N.s
	1	13	10	75	14.1538	206.306	11.8967	124.905
	2	9	30	75	65.5526	826.077	51.092	200.567
	3	10	10	160	0.805016	12.3773	0.313041	4.40962
	4	3	30	160	1.53817	22.9871	0.873037	12.5004
	5	4	5.85786	117.5	1.68453	26.2095	1.03917	14.7893
	6	12	34.1421	117.5	7.27793	105.877	5.96667	66.8245
	7	8	20	57.3959	181.578	2366.83	84.1814	342.525
	8	7	20	177.604	0.723191	10.6263	0.245044	3.47593
	9	11	20	117.5	3.57336	51.5837	2.40466	31.7747
	10	1	20	117.5	3.52375	53.5422	2.61149	33.246
	11	2	20	117.5	3.56217	52.7933	2.42852	31.6451
	12	5	20	117.5	3.53794	50.0562	2.323	30.3821
	13	6	20	117.5	3.54857	48.8644	2.3534	30.6792

Contour Plot

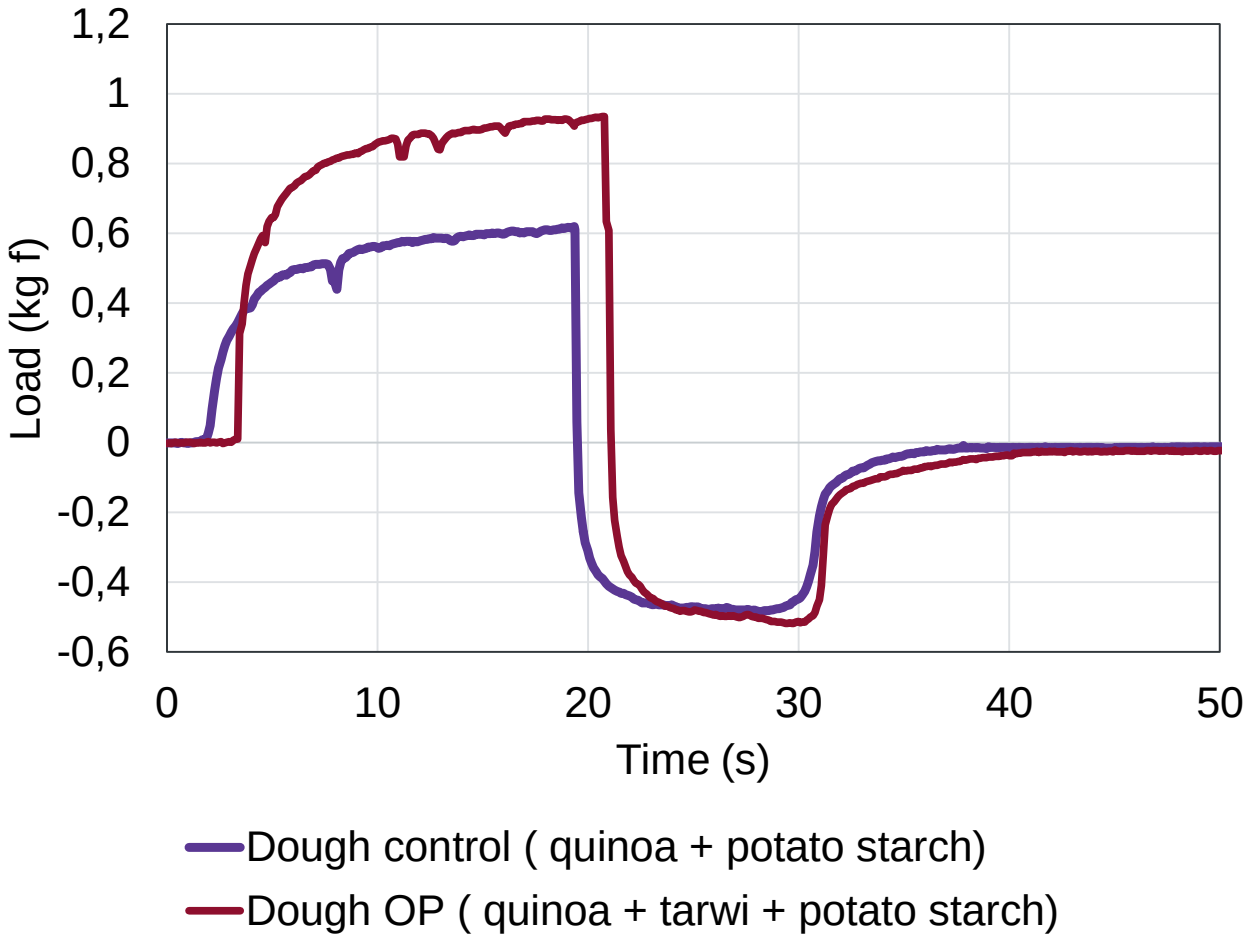


3D Surface Plot



Design-Expert® software
Mathematical modeling of responses

Results



The optimized formulation was:

- 12 % of tarwi flour
- 102% of water

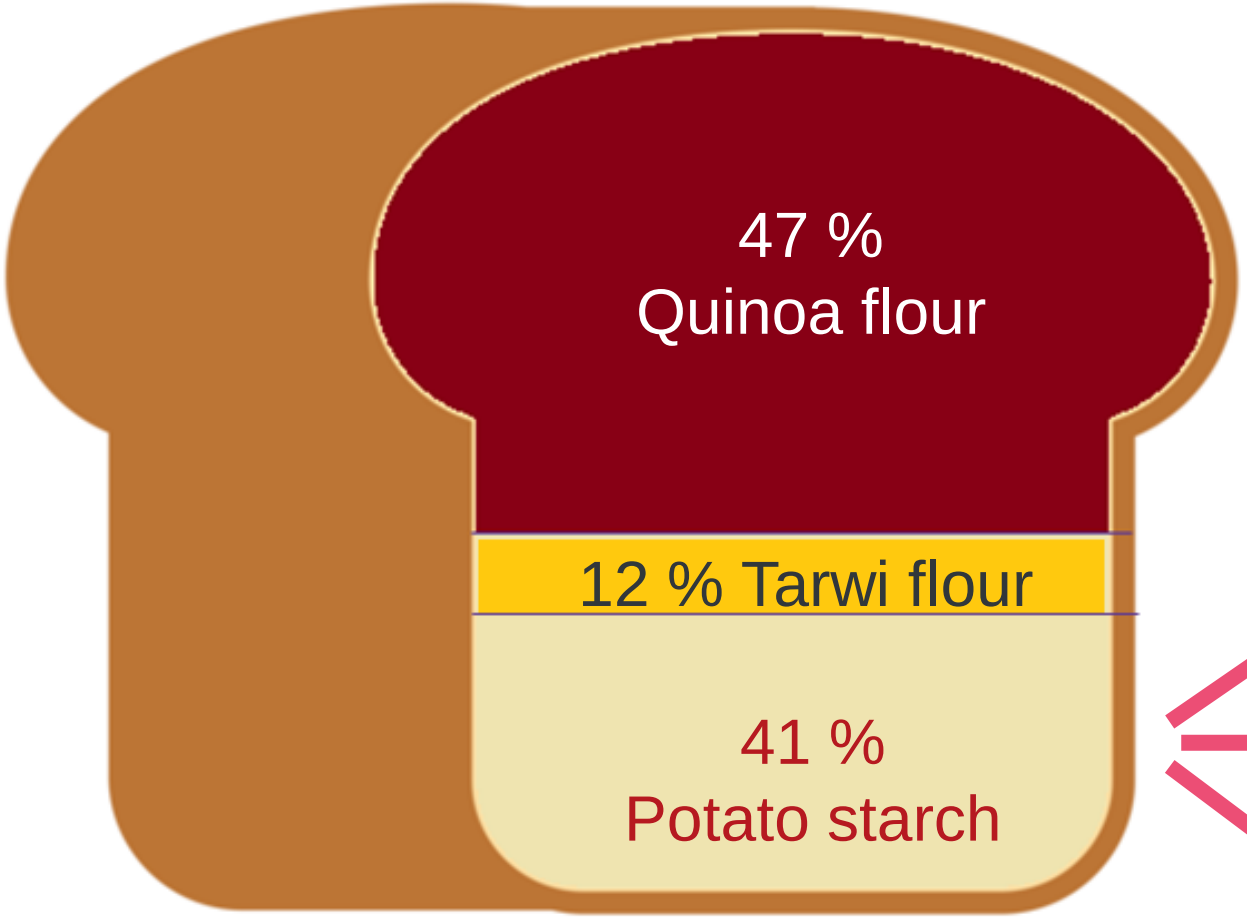
- 47% of quinoa flour
- 41% of potato starch

The rest of the components equal to the control formulation.

Textural Properties	GFD Control	GFD with tarwi flour
Firmness (N)	6.2 ± 0.1	10.2 ± 0.6
Consistency (N.s)	91.9 ± 1.4	145.3 ± 2.5
Cohesiveness (N)	5.0 ± 0.2	5.1 ± 0.1
Viscosity index (N.s)	56.0 ± 0.9	56.2 ± 0.3

Results

Influence of fermentation time in the final product



10 minutes

20 minutes

30 minutes

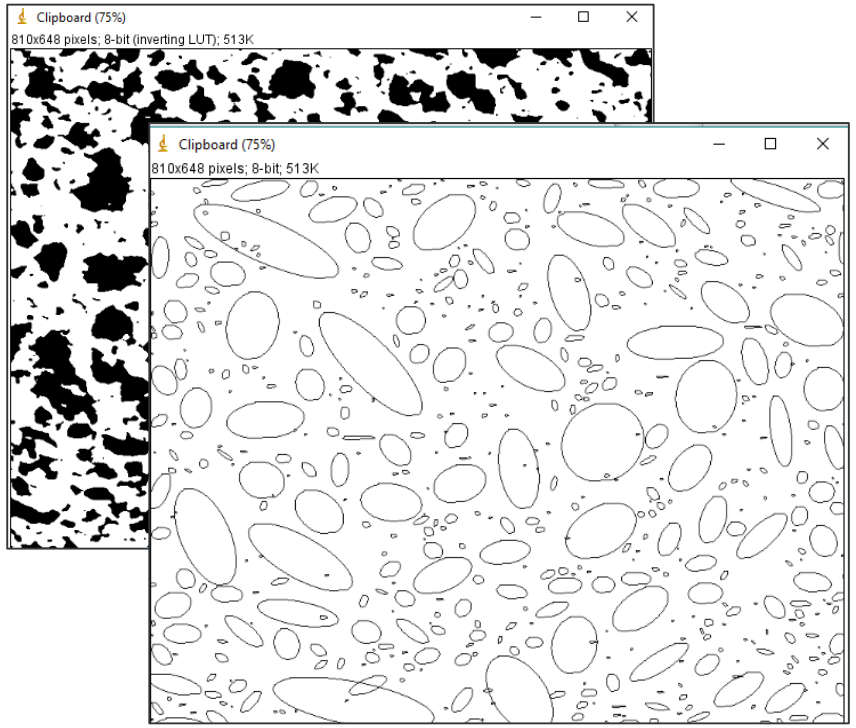
Baked for 60 minutes at 200 °C

102% of water, 0.5% mixture of xanthan gum and tara gum (ratio 1: 1) , 6% vegetable oil, 3% sugar, 2% salt and 3% yeast.

Results

Specific volume

Laser topography - Perten®



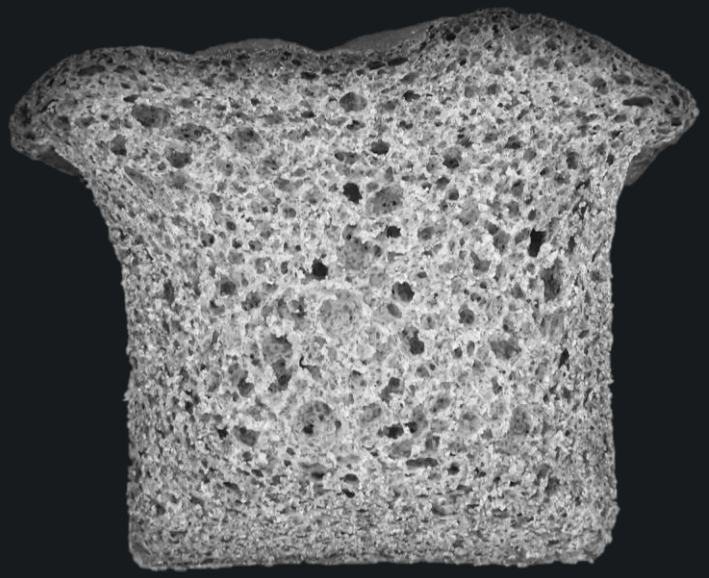
Alveolar structure

ImageJ 1.51j8 software - National Institutes of Health

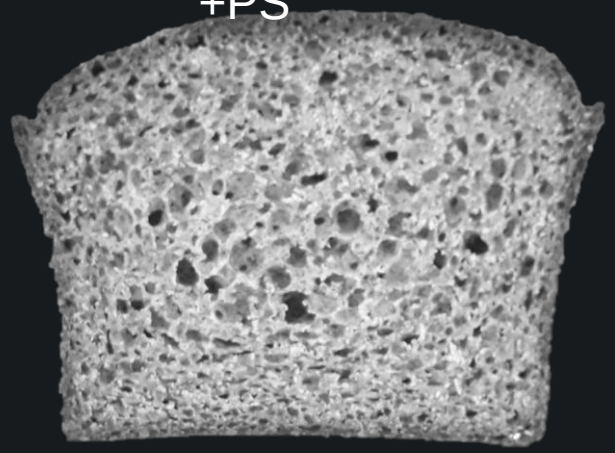
TPA

Instron Universal Testing Machine - INSTRON®

Results



GFB: Q +PS



GFB: Q + T+ PS

Bread quality parameters		Q + PS	Q+T+PS
Specific volume	(mL/g)	2.30 ± 0.04[a]	2.13 ± 0.03[b]
TPA - Crumb	Hardness (gf)	183.44 ± 27.2[a]	237.14 ± 26.4[b]
	Cohesiveness	0.31 ± 0.0[a]	0.39 ± 0.0[b]
	Elasticity	0.81 ± 0.1[a]	0.89 ± 0.0[a]
	Gumminess (gf)	55.53 ± 5.6[a]	91.31 ± 6.0[b]
	Chewiness (gf)	46.26 ± 5.3[a]	81.39 ± 5.2[b]
Crumb structure	N° cells/cm2	51.61 ± 3.1[a]	28.22 ± 2.4[b]
	% Area of cells	31.06 ± 0.1[a]	29.95 ± 3.5[a]

Conclusions

- A gluten-free bread was developed with whole-grain quinoa flour, tarwi flour and potato starch.
- The inclusion of tarwi flour increased the amount of water in the formulation.
- The gluten-free bread developed contains **59%** of highly nutritious wholemeal flours, achieving **13% of proteins**. Compared with the commercial brand which has around **3.8% of proteins**.

Gluten-free bread with quinoa flour, tarwi flour and potato starch

The developed gluten-free bread contains a better nutritional profile than the commercial brands and has good quality characteristics such as soft crumb and good specific volume.

Acknowledgment

The authors would like to thank the PROTEIN2FOOD Project (European Union's Horizon 2020, No. 635727) for the financial support of this research.

The speaker wishes to thank CONCYTEC for financing the PhD studies.

PROTEIN 2FOOD

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Thank you for your attention

MSc. Julio Mauricio Vidaurre-Ruiz

Programa Doctoral en Ciencia de Alimentos

Universidad Nacional Agraria La Molina

E-mail: vidaurrejm@lamolina.edu.pe

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