

Beans and peas as dough ingredients

PART 1: THE GERMAN COMPANY MÜLLER'S MÜHLE TESTED THE BAKING TECHNOLOGY PROPERTIES OF PULSE FLOURS AND RICE BRAN AND COMPARED THEM TO STANDARD WHEAT

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Part 2 with the results on freshness and freeze-thaw stability and a summary is available on our website!

+ Flours made from broad beans or pearl peas (also known as split peas) have been used as raw materials in bread production since ancient times. When dosed appropriately, these ingredients provide technological and sensory benefits. Scientific tests, commissioned by Mühler's Mühle, Gelsenkirchen, Germany, show the impact of such flours on color, smell, volume, proofing and thawing stability as well as on the freshness properties of baked goods. In particular, flours made from pearl peas yielded positive results. Part 2 of the article with the results on freshness and freeze-thaw stability and a summary is available on our website www.bakingbiscuit.com.

Experimental design:

For the determination of the baking technological properties, pulse flours (broad beans and pearl peas) as well as rice bran were used in different quantities. The pulse flours were used either untreated or in a heat treated version where the enzymes inherent to the product had been inactivated by heating in an oven (roasting). For that purpose, the flours were heated at 125 °C for 15 minutes with a core temperature of 95 °C. For the baking trials, the different pulse flours and the rice bran were added in amounts of one, three and five baker's percent. Added to that the freshness of the products was also investigated over a storage period of seven days; the volume of the baked goods was determined and the freeze-thaw-stability of dough pieces evaluated (see part 2). For the assessment of the baking properties, the experience gained during the processing of the dough was also recorded. After baking, the parameters crumb, pore size, sensory properties such as smell and taste were also assessed.

Broad beans (unroasted)

During dough preparation, the dough structure solidifies with increasing amounts of broad bean flour because the water available for the dough formation is affected by the higher amount of dry matter. The extensibility of the dough is also reduced. At low usage amounts, unroasted broad beans yield brighter dough. This can already be observed during the preparation of the dough which is brighter/whiter than a standard wheat dough. This effect diminishes with a usage amount of 5% broad beans. The same can be experienced for the baked goods. Only a usage of 1 or 3% makes the crumb brighter; a 5% dosage does not have this effect. An addition of 5% broad bean flour also changes the pore size, making the pores larger. The addition of 3 or 5% results in the development of a slightly sour smell and taste. For

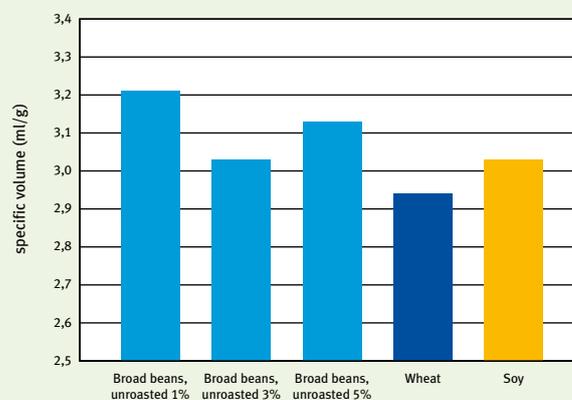
Table 1: Dough properties – broad beans (unroasted)

Dough properties	Broad beans, unroasted 1%	Broad beans, unroasted 3%	Broad beans, unroasted 5%
Texture	slightly firm	firm	firm
Extensibility	extensible	slightly extensible	slightly extensible
Stickiness	dry	dry	dry

Table 2: Baked goods properties – broad beans (unroasted)

Properties of the baked good	Broad beans, unroasted 1%	Broad beans, unroasted 3%	Broad beans, unroasted 5%
Color of the crumb	white	white	almost white
Properties of the crumb	elastic	elastic	elastic
Pore size	fine	fine	medium
Taste	neutral	slightly sour	slightly sour
Smell	neutral	slightly sour	slightly sour
Distinctive features	less tendency to clump	tendency to clump	strong tendency to clump, darker crust color

Figure 1: Volume of rolls made with unroasted broad bean flour



both products, the crumb has a tendency to clump. Compared to the standard wheat product, the volume is much larger for all three dosage amounts. Table 2 shows a comparison of the properties of the baked good. Figure 1 shows the volume of rolls made with broad bean flour, wheat or soy meal.

Broad beans (roasted)

Roasted broad beans display similar properties as unroasted broad beans. The higher the added amount of pulse flour, the firmer the dough (Table 3). One negative effect is that with a dosage of 3% and more the dough is difficult to extend and tends to break. These properties are not desired for bread. During roasting, the broad beans lose a lot of their moisture (about 10%) which means that this water is no longer available for the dough formation.



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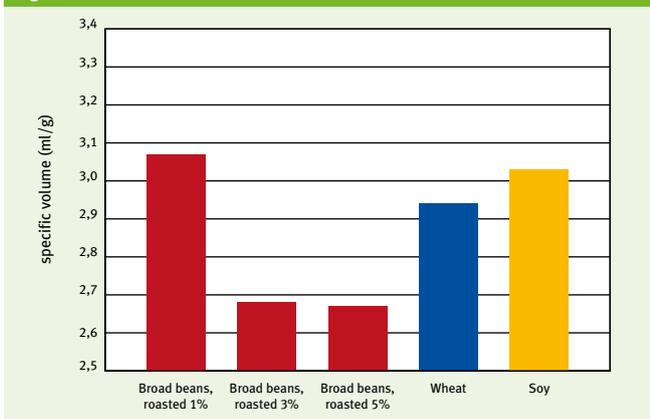
Table 3: Dough properties – broad beans (roasted)

Dough properties	Broad beans, roasted 1%	Broad beans, roasted 3%	Broad beans, roasted 5%
Texture	soft	firm	very firm
Extensibility	well extensible	shorter	short
Stickiness	dry	dry	dry

Table 4: Baked goods properties – broad beans (roasted)

Properties of the baked good	Broad beans, roasted 1%	Broad beans, roasted 3%	Broad beans, roasted 5%
Color of the crumb	greyish	greyish	greyish
Properties of the crumb	elastic	elastic	elastic
Pore size	fine	fine	fine
Taste	neutral	slightly sour	slightly sour
Smell	neutral	slightly sour	slightly sour
Distinctive features	tendency to clump	strong tendency to clump	strong tendency to clump

Figure 2: Volume of rolls made with roasted broad bean flour



With the roasting process, broad beans will lose their brightening property (compare tables 2 and 4). Dough and the crumb of the baked goods are grey. The addition of 3 or 5% also results in the development of a slightly sour smell and taste. In both products, the crumb has a clear tendency to clump. The addition of 3 or 5% broad bean flour reduces the volume significantly compared to the 1% dosage. This reduction in volume can be contributed to the roasting process (compare figures 1 and 2). The inactivation of the enzymes yields a lower volume and the lower moisture in the roasted beans reduces the freshness properties.

Rice bran

Products and dough made with rice bran have dark spots, that are clearly visible on the surface and are caused by the rice bran. The particle size of rice bran is larger by a factor of 10 compared to the particle size of pulse flours. Compared to standard wheat bread, such products are visually not attractive to the consumer. Dough made with 1 or 3% rice bran is still soft; it becomes firmer with a 5% addition. The extensibility of the dough is also reduced with a 5% addition. The dough properties are summarized in table 5; the properties of the baked goods are listed in table 6.

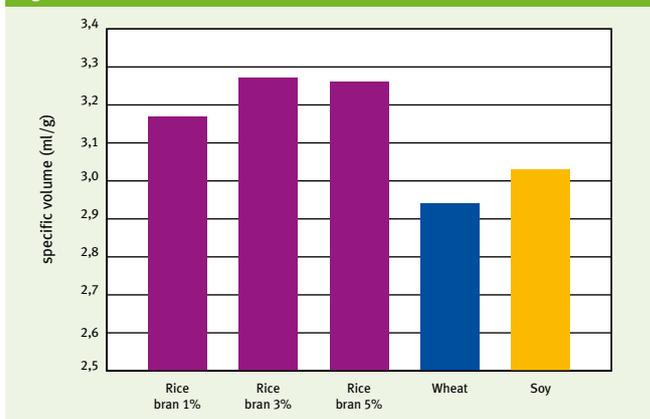
Table 5: Dough properties – rice bran

Dough properties	Rice bran 1%	Rice bran 3%	Rice bran 5%
Texture	slightly soft	slightly soft	firm
Extensibility	extensible	extensible	shorter
Stickiness	dry	dry	dry

Table 6: Baked goods properties – rice bran

Properties of the baked good	Rice bran 1%	Rice bran 3%	Rice bran 5%
Color of the crumb	greyish-brown	greyish-brown	greyish-brown
Properties of the crumb	elastic	elastic	elastic
Pore size	fine	fine	medium
Taste	unpleasant like rice	unpleasant like rice	unpleasant like rice
Smell	unpleasant like rice	unpleasant like rice	unpleasant like rice
Distinctive features	Spots on the surface caused by rice bran, all products have a tendency to clump, stronger with 5% addition		

Figure 3: Volume of rolls made with rice bran



All products made with rice bran have a greyish-brown crumb color. The baked goods resemble more a mixed rye bread than a wheat bread. Compared to the standard wheat bread, the taste and the smell change significantly with the added rice bran. All samples taste and smell characteristic of rice and they also tend to be musty. The crumb of all products has a tendency to clump. Added to that, baked goods containing rice bran have a large volume (figure 3).

Pearl peas (unroasted)

The use of pearl peas increases the firmness of the dough with a higher addition. However, the extensibility of the dough improves to the same extent; the addition of 5% pearl peas yields well extensible dough (table 7). As with broad beans, the pearl peas also have a brightening effect, even if the dosage is 5% (table 8). Compared to standard wheat bread, the crumb clearly has a lighter color after baking. The pore size changes from fine (1%) to medium (3 and 5%). All products have a tendency to clump; with 5% the crumb has a strong clumping tendency. Pearl peas produce, in baked goods, an aromatic smell and flavorful taste. The more pearl peas are added, the lower the volume of the baked goods. The addition of 1% pearl peas yielded the largest volume in rolls for the entire test series

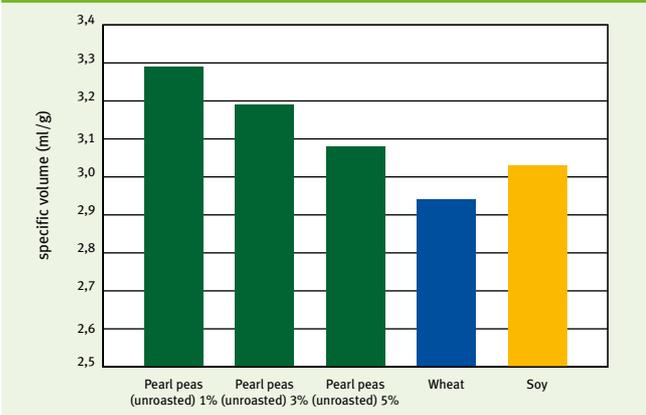
Table 7: Dough properties – pearl peas (unroasted)

Dough properties	Pearl peas unroasted 1%	Pearl peas unroasted 3%	Pearl peas unroasted 5%
Texture	soft	slightly firm	slightly firm
Extensibility	extensible	extensible	well extensible
Stickiness	dry	dry	dry

Table 8: Baked goods properties – pearl peas (unroasted)

Properties of the baked good	Pearl peas unroasted 1%	Pearl peas unroasted 3%	Pearl peas unroasted 5%
Color of the crumb	white	white	white
Properties of the crumb	elastic	elastic	elastic
Pore size	fine	medium	medium
Taste	slightly aromatic	slightly aromatic	aromatic
Smell	slightly aromatic	slightly aromatic	aromatic
Distinctive features	tendency to clump	tendency to clump	strong tendency to clump

Figure 4: Volume of rolls made with unroasted pearl peas



(3.29 ml/g). The addition of 3% and 5% reduced the volume significantly to 3.19 ml/g and 3.08 ml/g (figure 4).

Pearl peas (roasted)

As already observed with roasted broad beans, the texture and extensibility of the dough also change when roasted pearl peas are used. Extensibility was the property that experienced the largest change. Previously well extensible dough will develop short properties when roasted pearl peas are added in dosages of 3 and 5%. Table 9 summarizes the dough properties of products made with roasted pearl pea flour. The crumb of the baked goods is almost white and only slightly darker as with unroasted pearl peas. Taste and smell for all products is flavorful. With increasing the amount of roasted pearl pea flour the crumb’s tendency to clump increases. The volume of the rolls made with 1% roasted pearl pea flour corresponds to the volume of rolls made with 1% unroasted pearl pea flour (compare figures 4 and 5). As with the unroasted pearl pea flour, the volume of the baked goods decreases with increasing amounts of pearl peas. With roasted pearl peas, the effect is much clearer as for products with 5% addition; the volume is lower than that of the standard wheat product. This effect is also attributed to the roasting process.

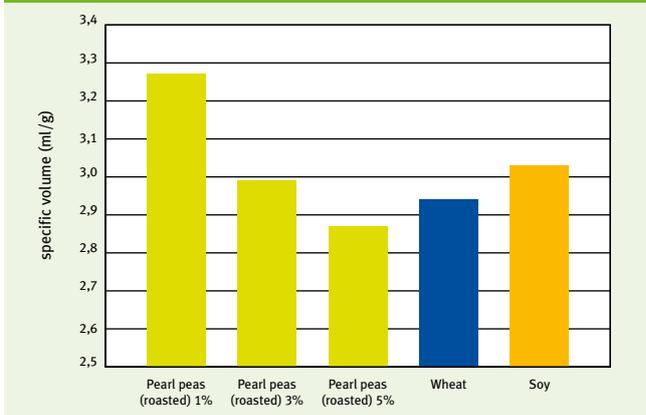
Table 9: Dough properties – pearl peas (roasted)

Dough properties	Pearl peas roasted 1%	Pearl peas roasted 3%	Pearl peas roasted 5%
Texture	slightly firm	slightly firm	firm
Extensibility	well extensible	short	short
Stickiness	dry	dry	dry

Table 10: Baked goods properties – pearl peas (roasted)

Properties of the baked good	Pearl peas roasted 1%	Pearl peas roasted 3%	Pearl peas roasted 5%
Color of the crumb	almost white	almost white	almost white
Properties of the crumb	elastic	elastic	elastic
Pore size	fine	fine	medium
Taste	aromatic	aromatic	aromatic
Smell	aromatic	aromatic	aromatic
Distinctive features	slight tendency to clump	tendency to clump	strong tendency to clump

Figure 5: Volume of rolls made with roasted pearl peas



Standard wheat and soy 0.5%

For comparison purposes, dough and baked goods were also made from standard wheat or with 0.5% soy meal. For such products no significant deviations in terms of dough and baked goods properties could be identified. The only exception is the different extensibility of the dough. While the standard wheat dough has a good extensibility, the addition of 0.5% soy meal clearly reduces the extensibility of the dough. The volume of the baked goods has already been depicted in figures 1-5 as a comparison with the other products. +++

Table 11: Dough properties – wheat and soy

Dough properties	Wheat	Soy
Texture	soft	soft
Extensibility	well extensible	short
Stickiness	dry	dry

Table 12: Baked goods properties – wheat and soy

Properties of the baked good	Wheat	Soy
Color of the crumb	greyish	greyish
Properties of the crumb	elastic	elastic
Pore size	medium	medium
Taste	aromatic	aromatic
Smell	neutral	neutral
Distinctive features	neutral	neutral