The eating rate of bread predicted from its Sensory texture and physical properties

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Table 1. Liking ratings of the breads. Values are mean ± SEM.

Bread type	Liking
Wholemeal bread slice	43 ± 3
Brown bread slice	42 ± 3
White bread slice	50 ± 3
Hard brown bun	72 ± 2
Hard white bun	72 ± 2
Ciabatta	75 ± 2
Soft brown bun	58 ± 3
Soft white bun	62 ± 3
Croissant	85 ± 2
P	***<0.001***

Table 2. Pearson correlations coefficients of average values of eating rate (g/min) with oral processing parameters, sensory texture, liking, and physical properties.

	Pearson correlation coefficient eating rate	**P**
Oral processing behaviour		
Bite weight (g)	**0.8**	**<0.01**
Bite volume (cm^3)	**0.66**	**0.05**
Chews per gram (g^{-1})	**-0.93**	**<0.001**
Chews per bite (-)	-0.37	0.33
OSE (s/g)	**-0.97**	**<0.001**
Chewing frequency (s^{-1})	0.12	0.75
Saliva incorporation (g/g)	0.20	0.60
Sensory texture		
Hardness crumb	-0.30	0.43
Dryness crumb	**-0.85**	**<0.01**
Chewiness crumb	-0.39	0.30
Adhesiveness crumb	**0.68**	**0.05**
Compactness crumb	0.04	0.92
Hardness crust	-0.51	0.16
Crispiness crust	0.26	0.49
Crumbliness crust	0.30	0.44
Hedonic ratings		
Liking	**0.78**	**0.01**
Physical properties		
Maximum height (cm)	**0.87**	**<0.01**
Volume (cm^3)	**0.76**	**0.02**
Density (g/cm^3)	0.14	0.73
Crust : crumb ratio (-)	0.52	0.15
Hardness crumb (g)	0.07	0.87
Springiness crumb (-)	-0.49	0.18
Cohesiveness crumb (-)	**-0.68**	**0.05**

Chewiness crumb (g)	-0.30	0.44
Resilience crumb (-)	-0.44	0.23
Adhesiveness crumb (g*s)	-0.08	0.85
Hardness crust (g)	**-0.76**	**0.02**
Moisture content (wt%)	-0.48	0.19
WAC (g_{water}/g_{bread})	-0.46	0.22

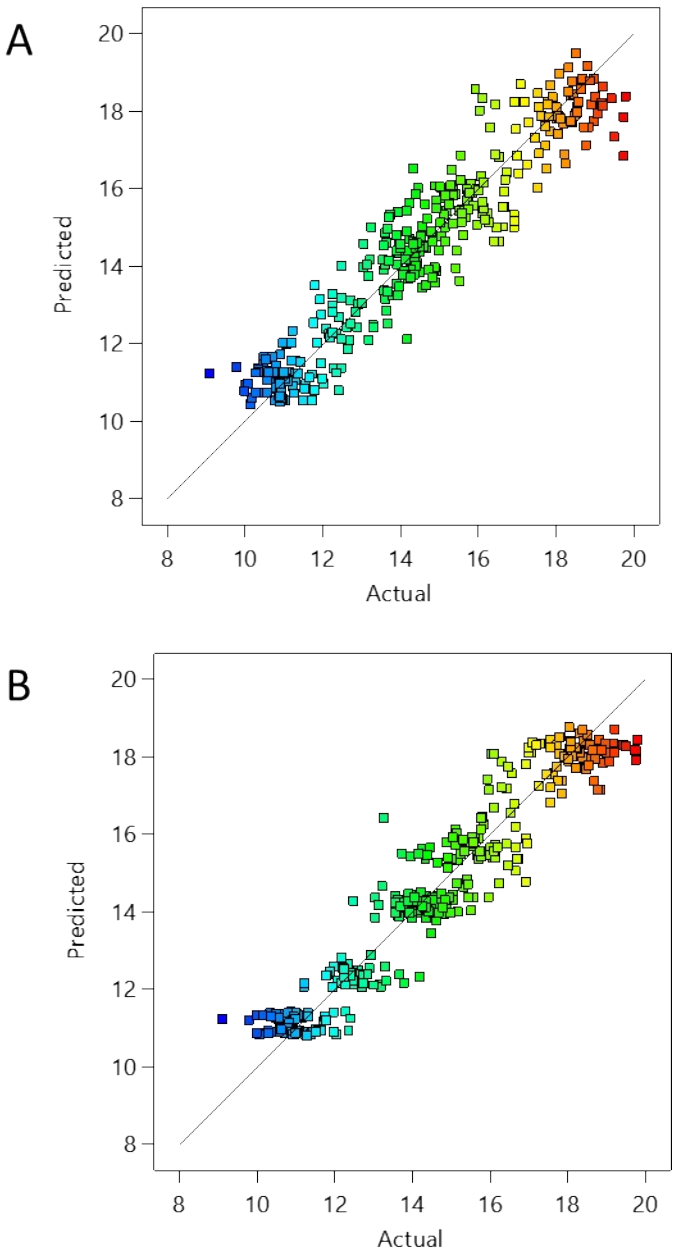

Figure 1. The predicted eating rate versus actual (measured) eating rate (g/min) based on leave-one-out cross-validation of the sensory texture model (A) and model based on physical properties (B). The black line indicates predicted eating rate equals actual (measured) eating rate. The color points indicate the value of eating rate

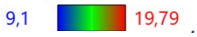

Table 3. Equations of the models in terms of actual factors (in original units) of the sensory texture model and model based on physical properties. This equation should not be used to determine the relative impact of each factor because the coefficients are scaled to accommodate the units of each factor. WAC water absorptive capacity, MC moisture content.

Model	Equation
Sensory texture model	Eating Rate = +26.13 -0.38 * Dryness Crumb -0.25 * Hardness Crust +0.0012 * Hardness Crumb * Hardness Crust -0.000081 * Adhesiveness Crumb * Crumbliness Crust +7.90 E-06 * Crispiness Crust * Crumbliness Crust +0.0038 * Dryness Crumb ^{2} +0.0023 * Hardness Crust ^{2}
Physical properties model	Eating Rate = +24.44 -2.51* Maximal Height * Adhesiveness Crumb +8.38 * Crust : Crumb Ratio * Adhesiveness Crumb -15.25 * Springiness Crumb * WAC -42.04 * Cohesiveness Crumb * MC +14.55 * Cohesiveness Crumb * WAC

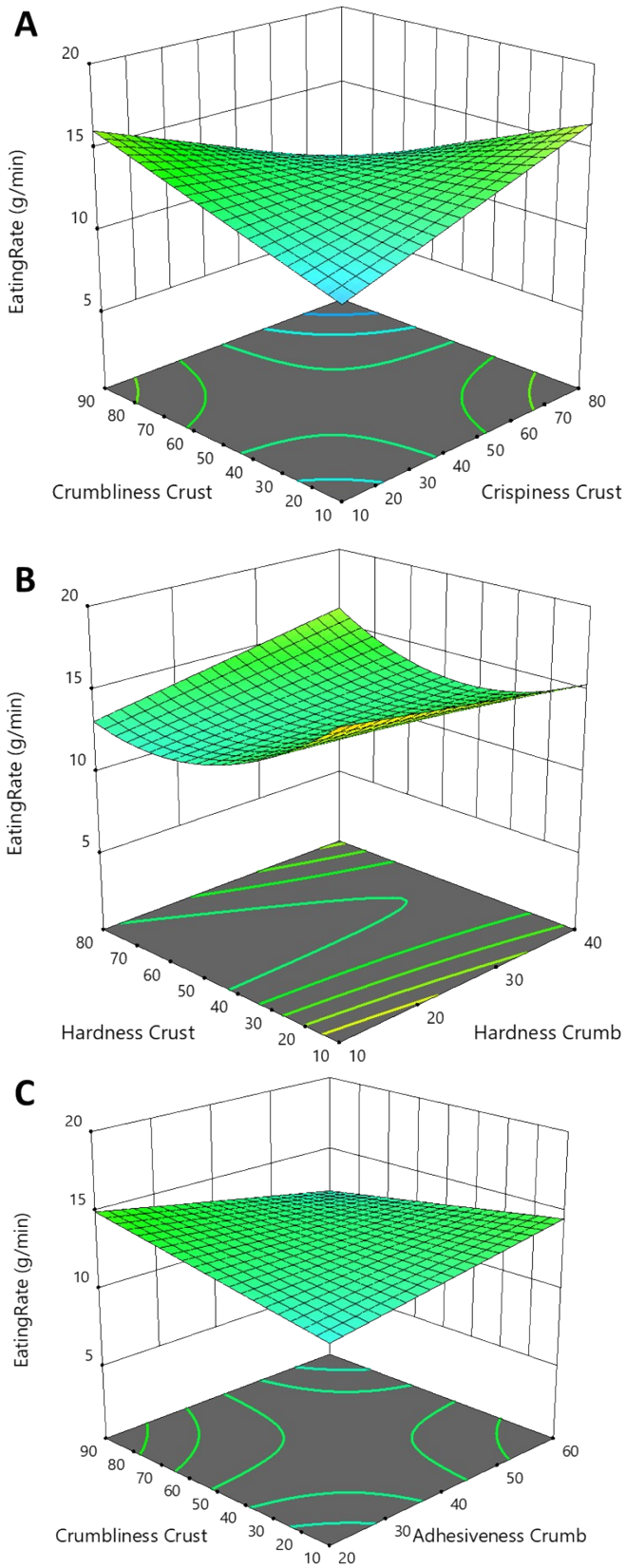

Figure 2. Surface plots of the RSM interaction terms of the sensory texture model. The gradient in the plot indicate the eating rate (g/min), where a colour more towards blue indicates a lower eating rate and colour more towards red indicates a higher eating rate.

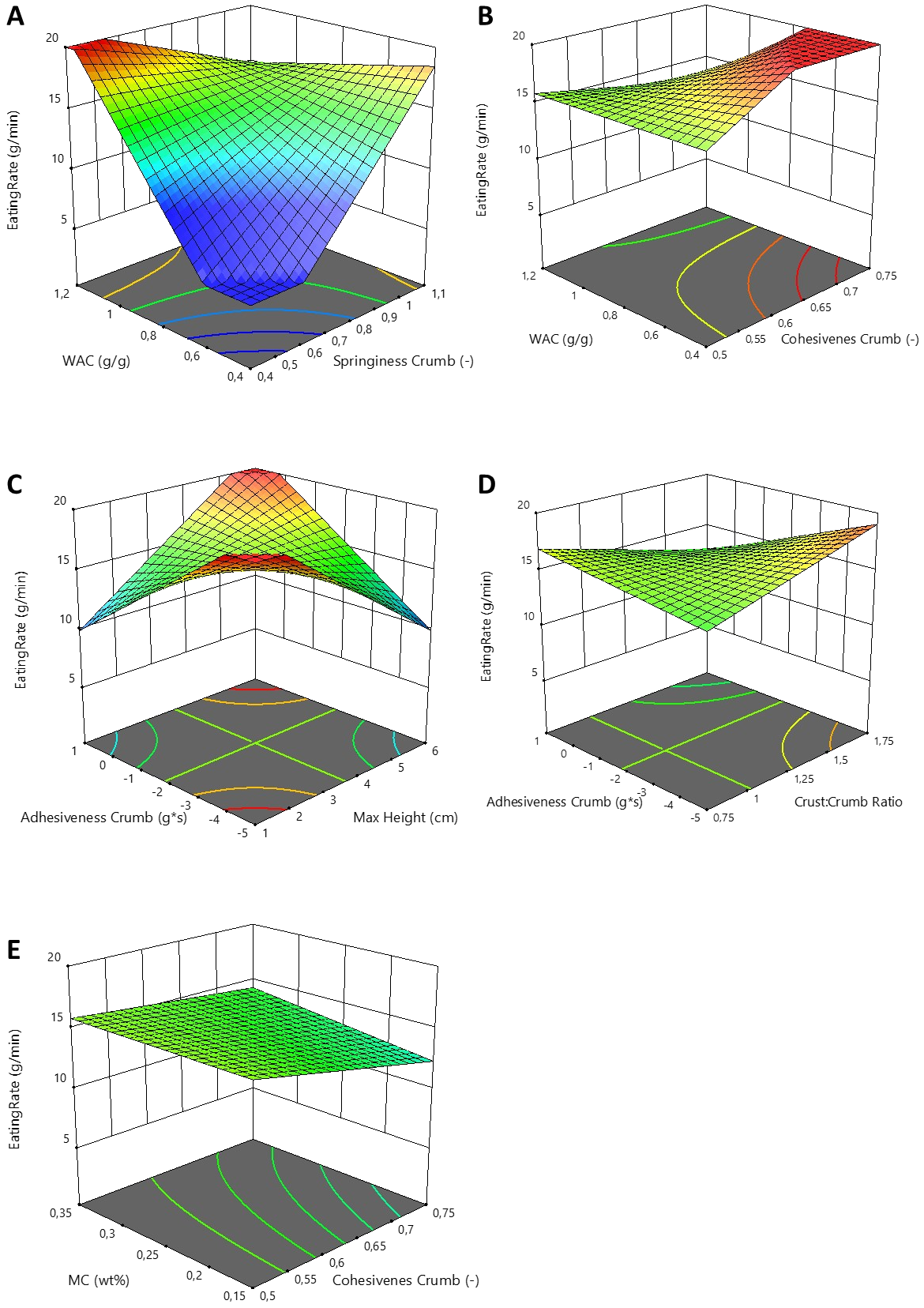

Figure 3. Surface plots of the RSM interaction terms of the model based on physical poperties. The gradient in the plot indicate the eating rate (g/min), where a colour more towards blue indicates a lower eating rate and colour more towards red indicates a higher eating rate.