

Impact of Apple Pomace Addition on the Chemical Composition of Blends and the Rheological Properties of Wheat Dough

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INTRODUCTION & AIM

The growing interest in reintroducing agro-industrial by-products into food production is driven by both environmental concerns and the demand for nutritionally enhanced products. **Apple pomace**, a by-product of juice processing, is rich in dietary fiber, polyphenols, and residual sugars and may serve as a functional ingredient in cereal-based formulations. **This study evaluated** the incorporation of apple pomace (5%, 10%, 15%, and 20% w/w) into two wheat-based raw materials—wheat flour type 750 and semolina—to assess its impact on flour composition and dough performance. Control samples consisting of 100% wheat flour or 100% semolina were also analyzed.

METHOD

The experimental material consisted of commercial **wheat flour** type 750 (Polskie Młyny, Poland) and **semolina** (Lubella, Poland), to which **apple pomace** (Maciejowy Sad, Poland) was added at levels of 5%, 10%, 15%, and 20%. The control samples consisted of wheat flour and semolina without apple pomace addition (0%). The apple pomace was lyophilized and ground using a WŻ-1 laboratory mill (Sadkiewicz Instruments, Bydgoszcz, Poland). **Chemical composition** analyses (total protein, gluten yield and spreadability, falling number, Zeleny sedimentation index, falling number), **amylographic** tests, **Mixolab** tests, and **farinographic** measurements were conducted to characterize both the flour blends and the resulting doughs.

RESULTS & DISCUSSION

Our results showed that semolina-based blends had higher protein content (up to 12.2%), gluten yield (21.2%), and peak paste viscosity (1049 AU) compared to flour-based ones. However, as the proportion of apple pomace increased, a consistent decline in total protein content (down to 10.4%), gluten yield (down to 13.4%), and dough extensibility was observed, along with a marked increase in water absorption (from 54.7% to 62.9%). These changes have significant implications for product development. Higher apple pomace levels impaired gluten quality, which may limit its use in breadmaking or other leavened applications. Nonetheless, lower inclusion levels (5–10%) maintained acceptable dough behavior, indicating potential for applications in pasta or flatbreads, where high extensibility is not critical.

Table 1. Average quality parameters of blends whet flour/ apple pomace

		Total protein [g/100 g d.m.]	Gluten yield [%]	Gluten Spreadability [mm]	Zeleny's sedimentation value [ml]	Falling number [s]
Apple pomace share [%]	0	12.4 a	28.3 a	4.9 a	24 a	331 a
	5	12,0 b	24.3 b	3.3 b	22 c	301 b
	10	11.8 c	18.9 c	1.6 c	23 b	300 b
	15	11.3 d	15.1 d	0.6 d	24 ab	286 c
	20	10.4 e	13.4 e	0.5 d	24 a	298 b
Wheat flour type	750	10.9 b	18.7 b	0.5 b	26 a	231 b
	semolina	12.2 a	21.2 a	3.9 a	20 b	375 a

Mean values marked with different letters in the same column within one factor indicate a statistical difference (a > b > c ... etc.) (p ≤ 0.05).

Table 2. Amylographic features of blends whet flour/ apple pomace

		Initial gelatinization temp. [°C]	Final gelatinization temp. [°C]	Gelatinization time [min]	Maximum viscosity [AU]
Wheat flour type	750	56.1 a	75.0 a	30.2 a	348.0 b
	semolina	57.7 a	71.1 a	27.5 a	1049.0 a
Apple pomace share [%]	0	60.8 a	74.3 a	29.5 a	487.5 a
	5	53.3 a	65.8 a	24.0 a	550.0 a
	10	60.0 a	79.5 a	33.0 a	622.5 a
	15	55.8 a	76.8 a	31.3 a	765.0 a
	20	54.8 a	69.0 a	26.5 a	1067.5 a

Mean values marked with different letters in the same column within one factor indicate a statistical difference (a > b > c ... etc.) (p ≤ 0.05).

RESULTS & DISCUSSION

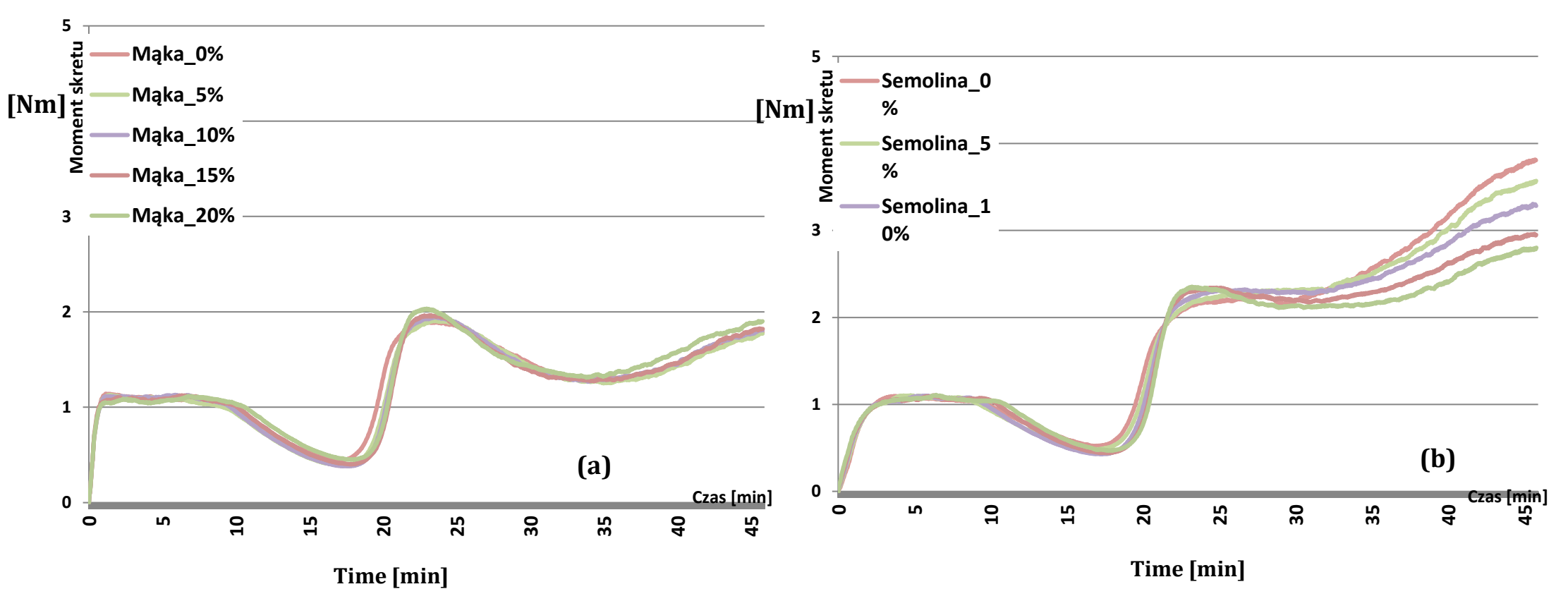


Figure 1. Mixolab diagrams for (a) wheat flour type 750 with apple pomace share (5-20%), (b) semolina with apple pomace share (5-20%)

Table 3. Farinographic features of blends whet flour/ apple pomace

		Initial gelatinization temp. [°C]	Final gelatinization temp. [°C]	Gelatinization time [min]	Maximum viscosity [AU]
Wheat flour type	750	61.4 a	3.2 a	9.9 a	53.6 a
	semolina	56.4 b	9.0 a	7.0 a	55.0 a
Apple pomace share [%]	0	54.7 e	5.5 a	5.3 a	65.0 a
	5	56.9 d	6.8 a	6.0 a	59.0 a
	10	59.2 c	6.0 a	9.0 a	57.0 a
	15	61.0 b	6.3 a	10.0 a	46.0 a
	20	62.9 a	6.0 a	12.0 a	41.0 a

Mean values marked with different letters in the same column within one factor indicate a statistical difference (a > b > c ... etc.) (p ≤ 0.05).

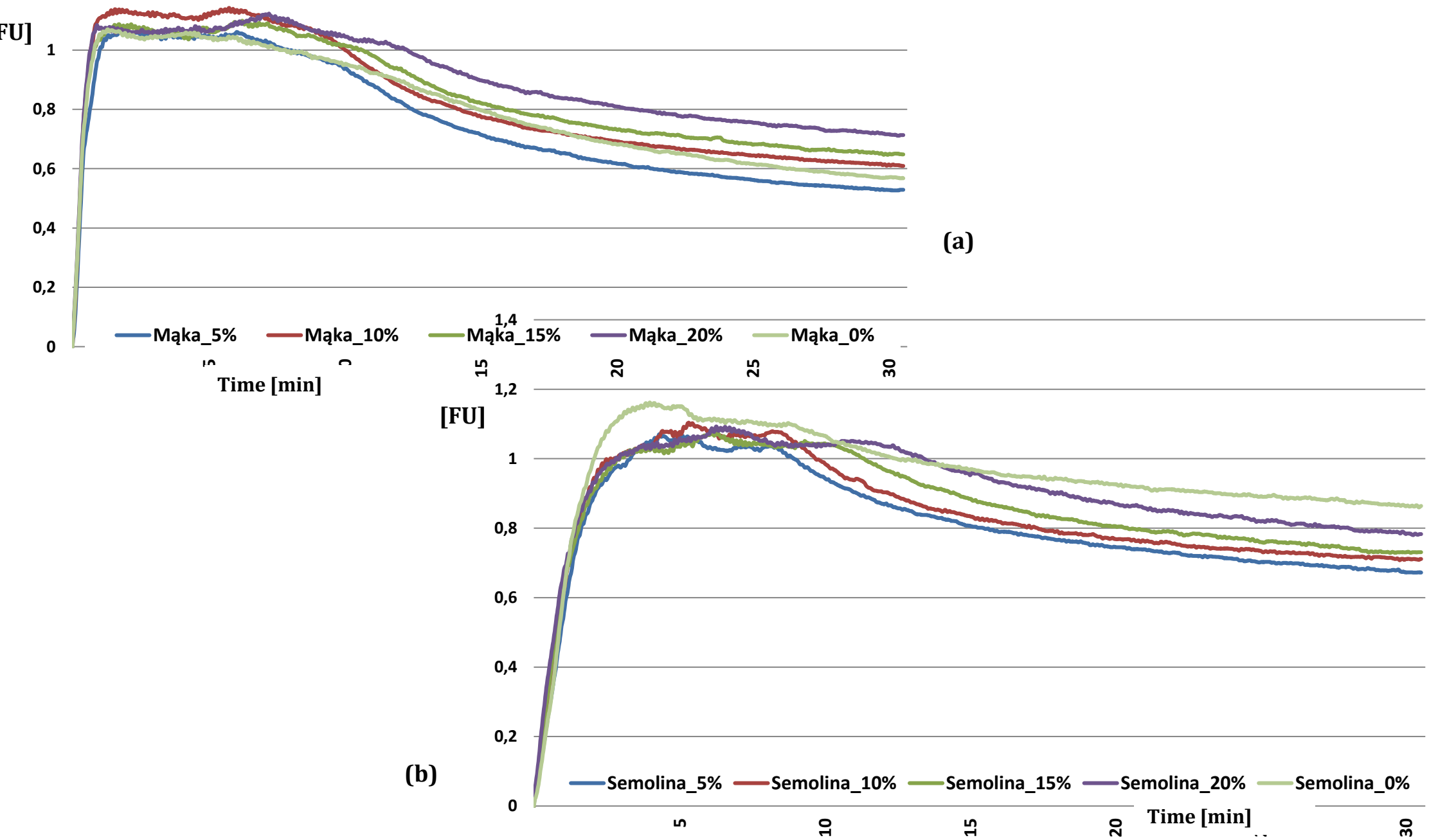


Figure 2. Farinographic diagrams for (a) wheat flour type 750 with apple pomace share (5-20%), (b) semolina with apple pomace share (5-20%)

CONCLUSION

This study highlights the potential of apple pomace as a sustainable, value-added ingredient that supports circular economy strategies in the food industry. Its use in cereal-based formulations can contribute to both nutritional enhancement and by-product valorization, provided that functional properties are carefully optimized depending on the target application.

FUTURE WORK

Future studies should optimize the functional and sensory properties of products with apple pomace and assess its impact on shelf life and consumer acceptance. Expanding its use in various cereal-based products could further support sustainable food production.