

THE INFLUENCE OF RAPESEED OIL-BASED OLEOGELS WITH RICE BRAN WAX AND BEESWAX ON THE FORMATION OF ACRYLAMIDE AND OXIDATIVE CHANGES IN THE DEEP-FRYING MEDIUM

Sylwia Onacik-Gür, Stanisław Ptasznik, Urszula Siekierko, Magdalena Skorupska
Department of Meat and Fat Technology, Prof. Waclaw Dabrowski Institute of Agriculture and Food Biotechnology–State Research Institute, 36 Rakowiecka Street, 02-532 Warsaw, Poland; sylwia.onacik-gur@ibprs.pl

Introduction

Prolonged use of frying media contributes to their degradation, resulting in the formation of hazardous chemical compounds. Fried products absorb these compounds along with the media, reducing their nutritional value. Excessive consumption of these products can lead to cardiovascular disease and increase the risk of cancer. During frying, the Maillard reaction occurs within the product. Reducing sugars and amino acids participate in this reaction. The products of this reaction are responsible for shaping the desired sensory characteristics of fried products, such as taste, aroma, and color. Unfortunately, some of these components can have a negative impact on human health. These substances include acrylamide. This compound is considered potentially carcinogenic and genotoxic by EFSA.

This study aimed to investigate the effect of adding rice bran wax (RW) and beeswax (BW) on the oxidative properties of a rapeseed oil-based frying media, as well as on fat absorption, quality parameters, and acrylamide content in fried French fries. Furthermore, the effect of the frying medium on the storage and sensory properties of potato crisps was examined.

1st stage – Properties of frying fat – French fries

The fries were fried in three cycles of 4 hours each day. Frying media used: RO – rapeseed oil, RW0.25 – rapeseed oil with 2.5g/L of rice bran wax, RW0.5 – 5g/L of rice bran wax, BW0.5 – 5g/L of beeswax, BW1 – 1g/L of beeswax



Fig. 1. Photos of fries fried in 1 cycle

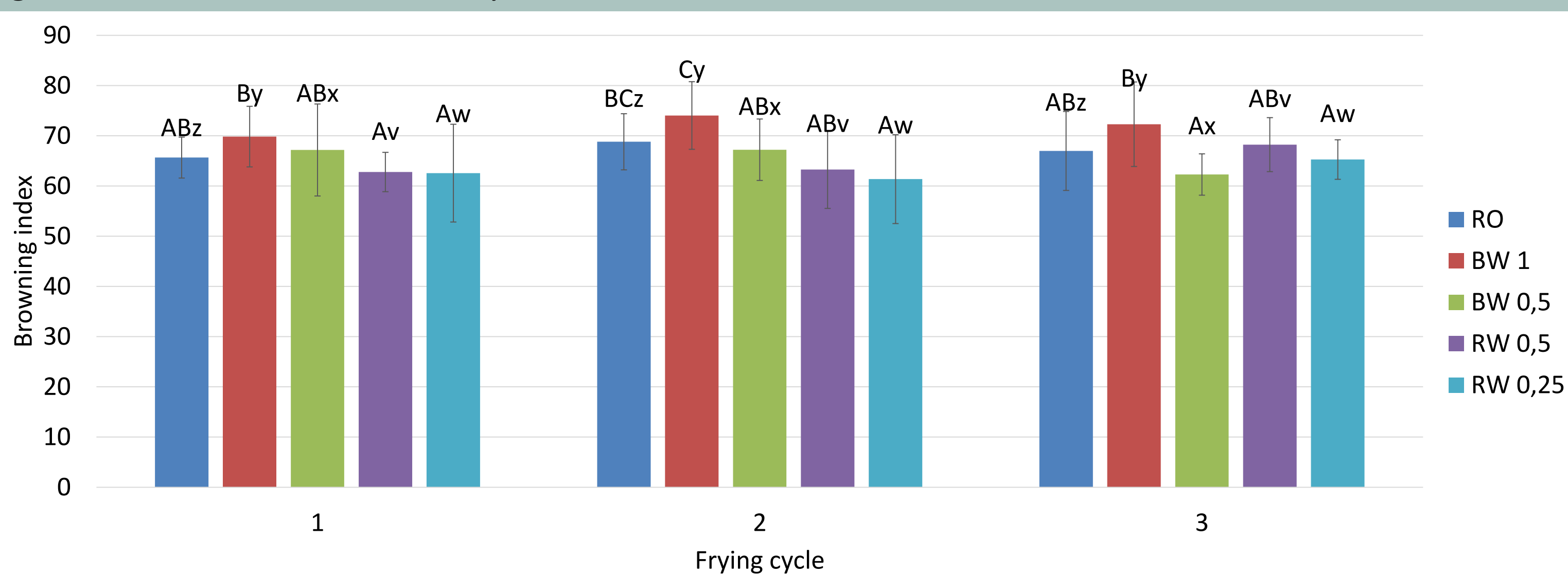


Fig. 2. Browning index of fries

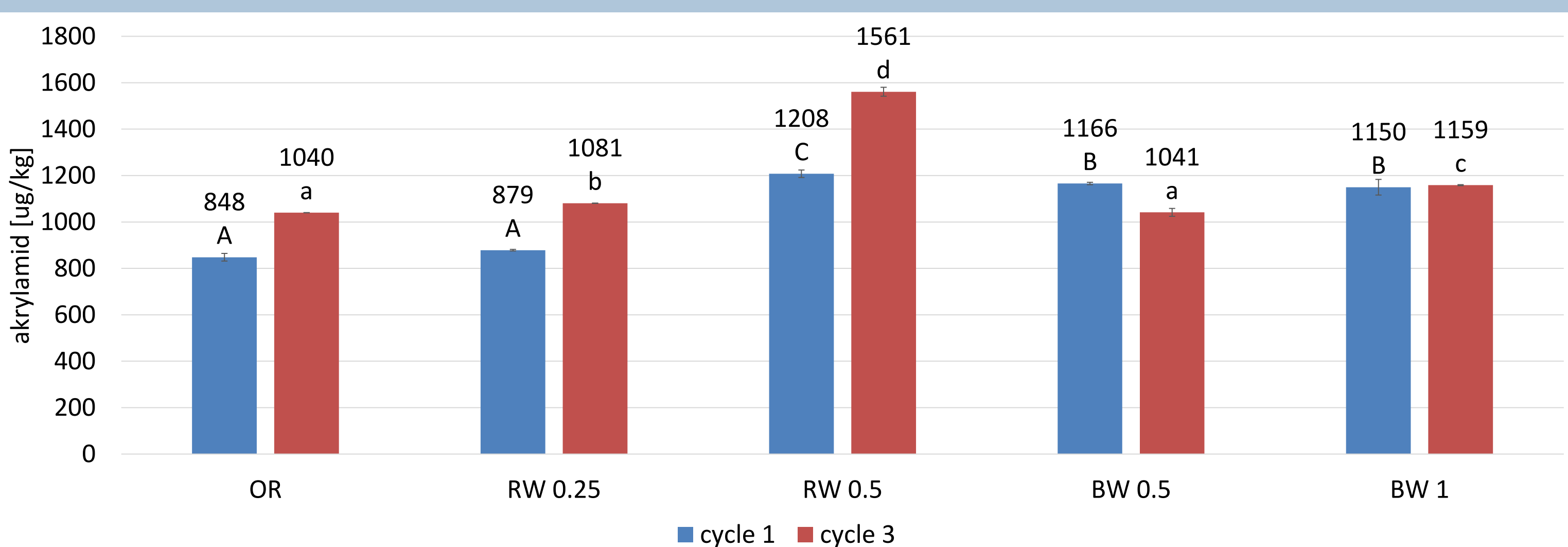


Fig. 3. Acrylamide content in fries [ug/kg]

Tab. 1. Peroxide value [PV] and acid value [AV] of frying media

Frying cycle	RO	BW 1	BW 0.5	RW 0.5	RW 0.25
AV (mg KOH/g)					
1	0.28 ± 0.01a	0.42 ± 0.00A	0.32 ± 0.02a	0.30 ± 0.01A	0.27 ± 0.01a
2	0.28 ± 0.02a	0.49 ± 0.01B	0.35 ± 0.01b	0.30 ± 0.03A	0.28 ± 0.02a
3	0.36 ± 0.04b	0.55 ± 0.02C	0.44 ± 0.03c	0.51 ± 0.04B	0.39 ± 0.04b
PV (meq O₂/kg)					
1	14.30 ± 0.8c	14.62 ± 0.05C	11.75 ± 0.13c	10.63 ± 0.04B	13.04 ± 0.02c
2	9.01 ± 0.04a	10.86 ± 0.19B	9.41 ± 0.14b	10.79 ± 0.04B	10.48 ± 0.13b
3	11.15 ± 0.06b	9.99 ± 0.33A	9.09 ± 0.06a	10.16 ± 0.06A	9.53 ± 0.53a

2nd stage – shelf-life – puffed potato chips

Tab. 2. Peroxide value [PV], acid value [AV], saturated fatty acids [SFA], monounsaturated fatty acids [MUFA], polyunsaturated fatty acids [PUFA] i trans fatty acids [TFA] of puffed potato chips lipid fraction

Medium	Time	AV (mgKOH/g)	PV (meqO ₂ /kg)	SFA	MUFA	PUFA	TFA
RO	1 day	0.25 ± 0.01 ^{Aa}	6.59 ± 0.01 ^{Ab}	7.5	65.5	26.3	0.6
	3 weeks	0.28 ± 0.05 ^{Aa}	24.35 ± 0.09 ^{Bc}	7.5	65.7	26.1	0.6
	6 weeks	0.27 ± 0.01 ^{Aa}	39.47 ± 0.01 ^{Cc}	7.6	65.8	25.9	0.6
	9 weeks	0.29 ± 0.01 ^{Aa}	67.84 ± 0.10 ^{Dc}	7.6	66.3	25.5	0.6
BW 0.5	1 day	0.30 ± 0.00 ^{Aa}	5.51 ± 0.13 ^{Ab}	7.6	65.4	26.3	0.6
	3 weeks	0.33 ± 0.03 ^{Aba}	21.16 ± 0.03 ^{Bb}	7.6	65.5	26.2	0.6
	6 weeks	0.36 ± 0.01 ^{Bb}	32.94 ± 0.02 ^{Ca}	7.7	65.7	25.9	0.6
	9 weeks	0.35 ± 0.00 ^{Bb}	52.62 ± 0.10 ^{Da}	7.9	65.8	25.7	0.6
RW 0.25	1 day	0.27 ± 0.08 ^{Aa}	6.38 ± 0.02 ^{Aa}	7.6	65.5	26.3	0.6
	3 weeks	0.30 ± 0.02 ^{Aa}	19.73 ± 0.04 ^{Ba}	7.6	65.6	26.1	0.6
	6 weeks	0.29 ± 0.04 ^{Aab}	34.89 ± 0.15 ^{Cb}	7.6	65.8	25.9	0.6
	9 weeks	0.30 ± 0.02 ^{Aa}	63.38 ± 0.13 ^{Db}	7.7	66.3	25.4	0.6



Fig. 4. Oil uptake [%]

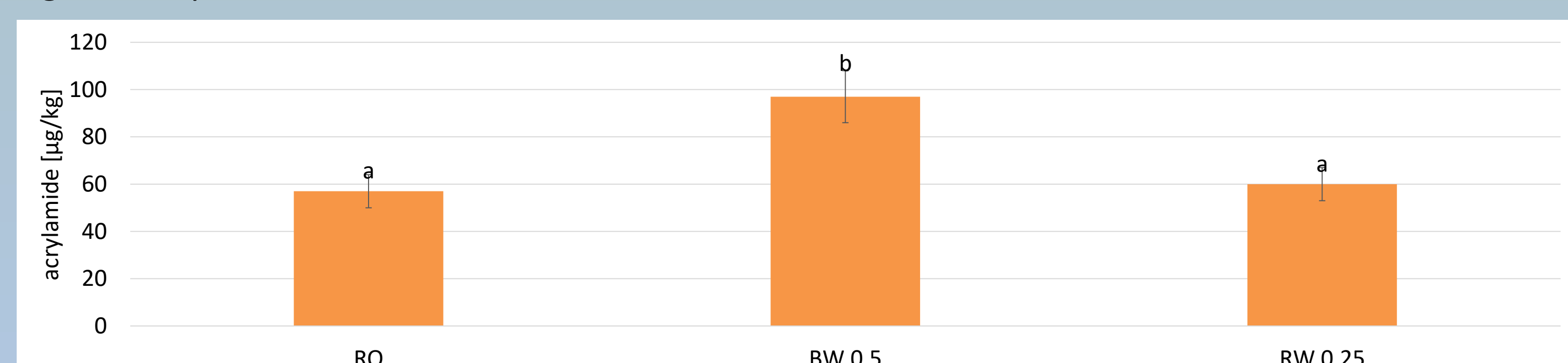


Fig. 5. Acrylamide content [ug/kg] in puffed potato chips

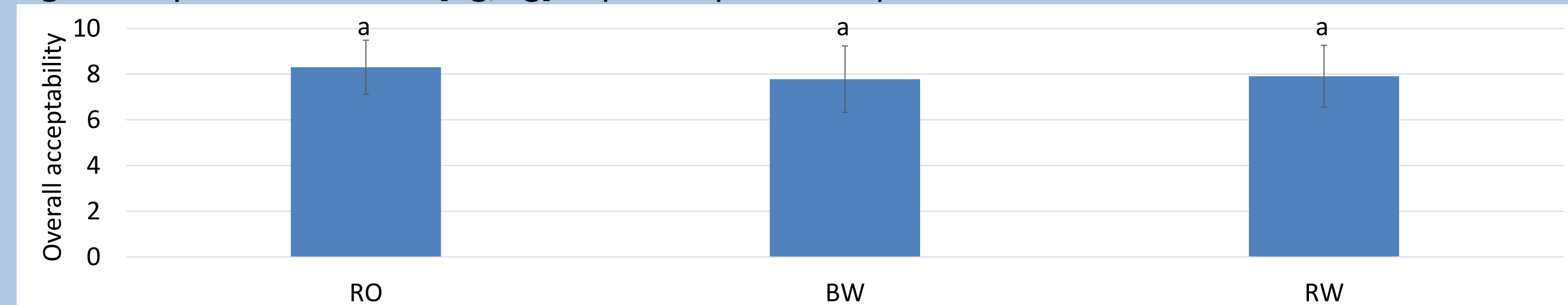


Fig. 6. Overall acceptability of puffed potato chips

Summary

Based on the obtained results, it can be concluded that the addition of waxes had a beneficial effect on reducing lipid oxidation in the chips products during storage and reducing oil absorption. The addition of rice bran wax had a statistically significant impact on the increase in acrylamide formation. In potato puffed chips, the addition of beeswax at a level of 0.5g/L increased the AA content by 70%. The results of the sensory analysis indicate that the addition of waxes to rapeseed oil did not affect the sensory properties. Considering all the results, benefits and risks, RW 0.25 oleogel is a more favorable frying medium and a promising solution for future applications.