

Improving the health quality of fried falafel (Middle Eastern food) by using transglutaminase and/or pectin coating

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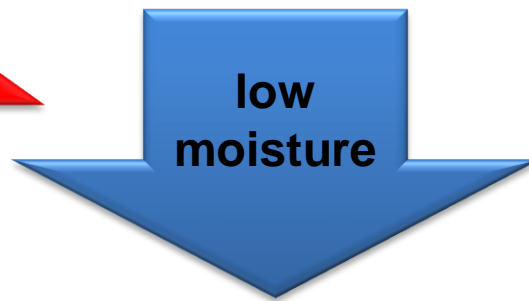
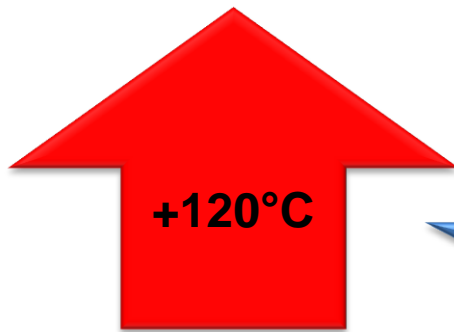
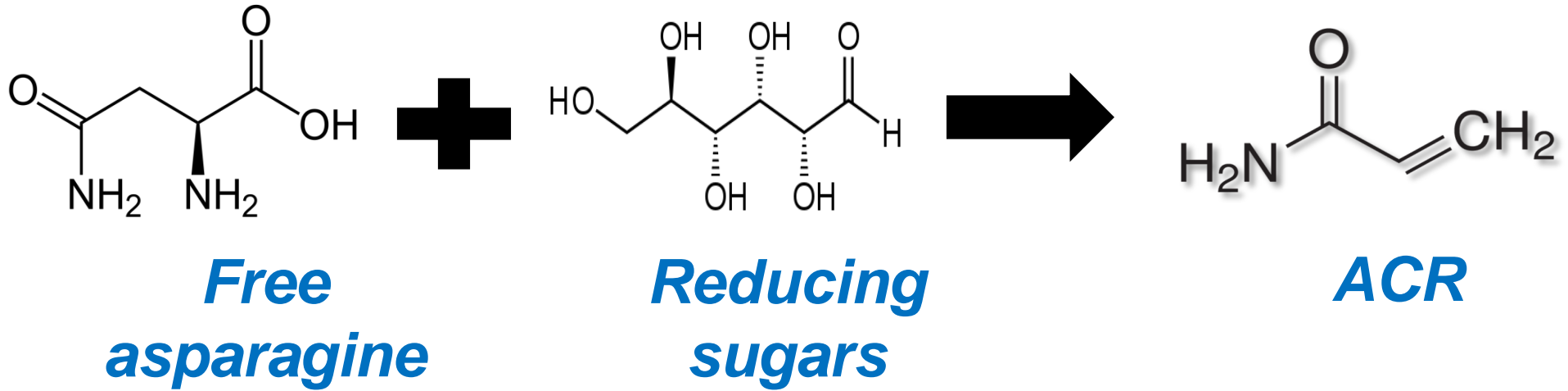
Background

- ❑ Falafel is traditionally fast and street food in Middle Eastern.
- ❑ Falafel dough is made of a mixture of soaked ground chickpeas, parsley, onions, spices and leavened by sodium bicarbonate.



- ❑ According to European Food Safety Authority (EFSA), acrylamide (ACR) is produced in numerous baked and fried foods, including French fries, potato crisps, breads, biscuits, and coffee (roasted beans). EFSA scientists conclude that ACR is a health concern (EFSA, 2015).

How can ACR be formed in foods?



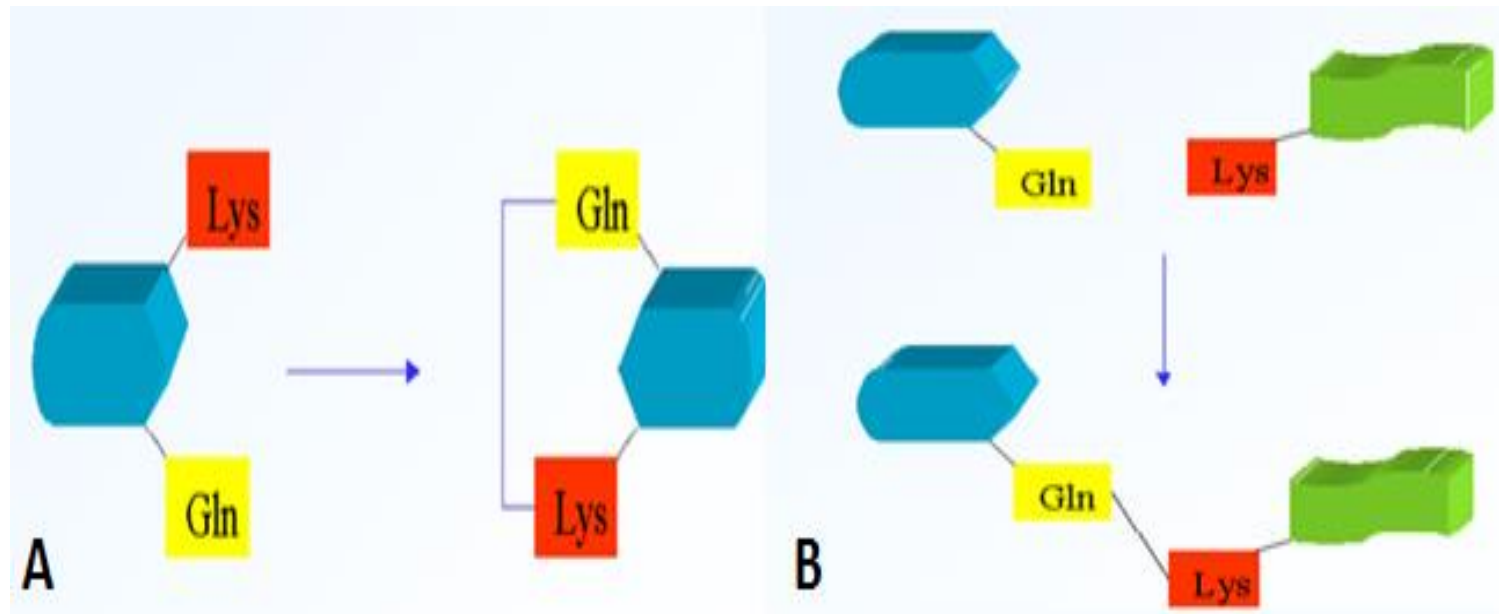
frying, baking, roasting

This reaction is part of the Maillard reaction

Objectives

- ❑ The objective of this study was to evaluate the effect of both TGase and PEC-based coating solution on the ACR formation and quality of the fried falafel.
- ❑ Oil and water content, texture analysis profile, and *in vitro* gastric digestion were investigated. Results demonstrated the effectiveness of our coatings providing healthier falafel.

Transglutaminase (E.C. 2.3.2.13, TGase)



TGase-mediated crosslinking can give rise to intra-molecular (A) and inter-molecular (B) isopeptidic bond.

Preparation of falafel balls

Soaking 200 g of dried chickpeas with 600 mL of water for overnight



Removing the chickpeas from the water



Onion, parsley, falafel spices, salt and sodium bicarbonate was added to mixture



Blending for 2 min

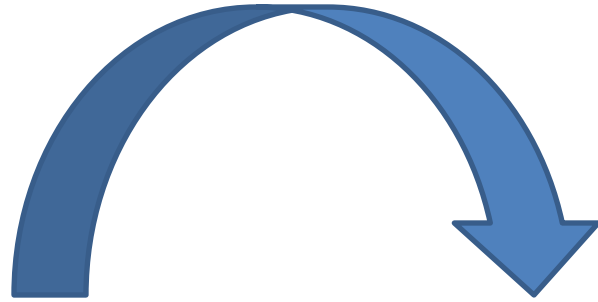


Preparation of balls by using falafel scoops (**Fig. 1**); frying them in hot oil (180°C) for 5 min



Fig. 1

Falafel prepared in the presences of TGase



add TGase : 0, 5, 20
U/g protein
incubation time : 2h
at 37 °C



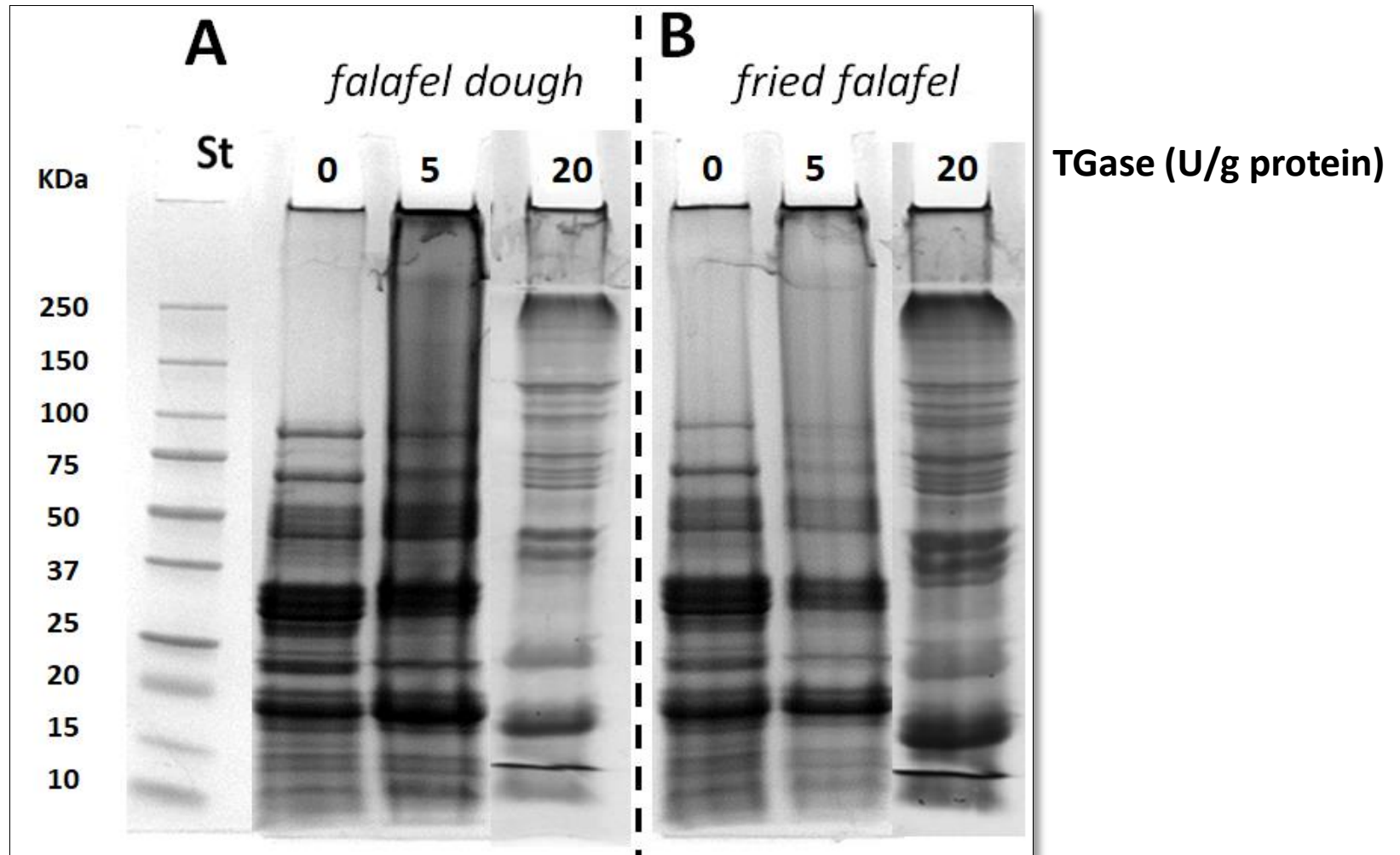
Falafel dough



Frying the falafel
balls at $180 \pm 5^\circ\text{C}$ for
5 min



SDS-page of falafel dough and fried falafel



Dipping and frying protocol

Preparing falafel dough **with** and without TGase 5, 20 U/g

Freezing for 2h at $-20\text{ }^{\circ}\text{C}$

dipped 30s in

Water as a control

PEC 1% pH 7.5

Control

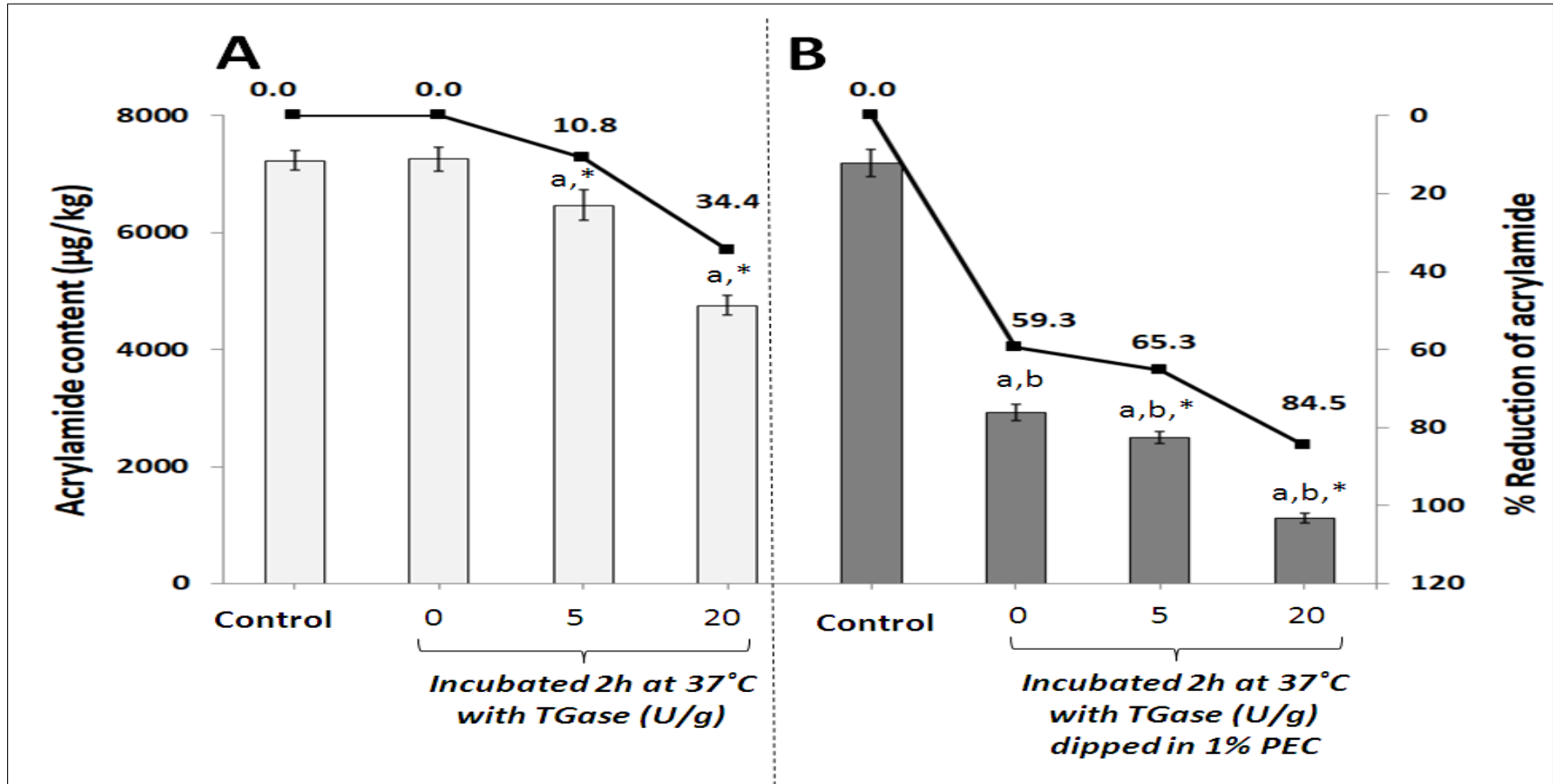
Freezing for 30 min at $-20\text{ }^{\circ}\text{C}$

Fried at $180 \pm 5\text{ }^{\circ}\text{C}$ for 5min

Effect of different concentrations of TGase on ACR content of fried falafel

without dipping

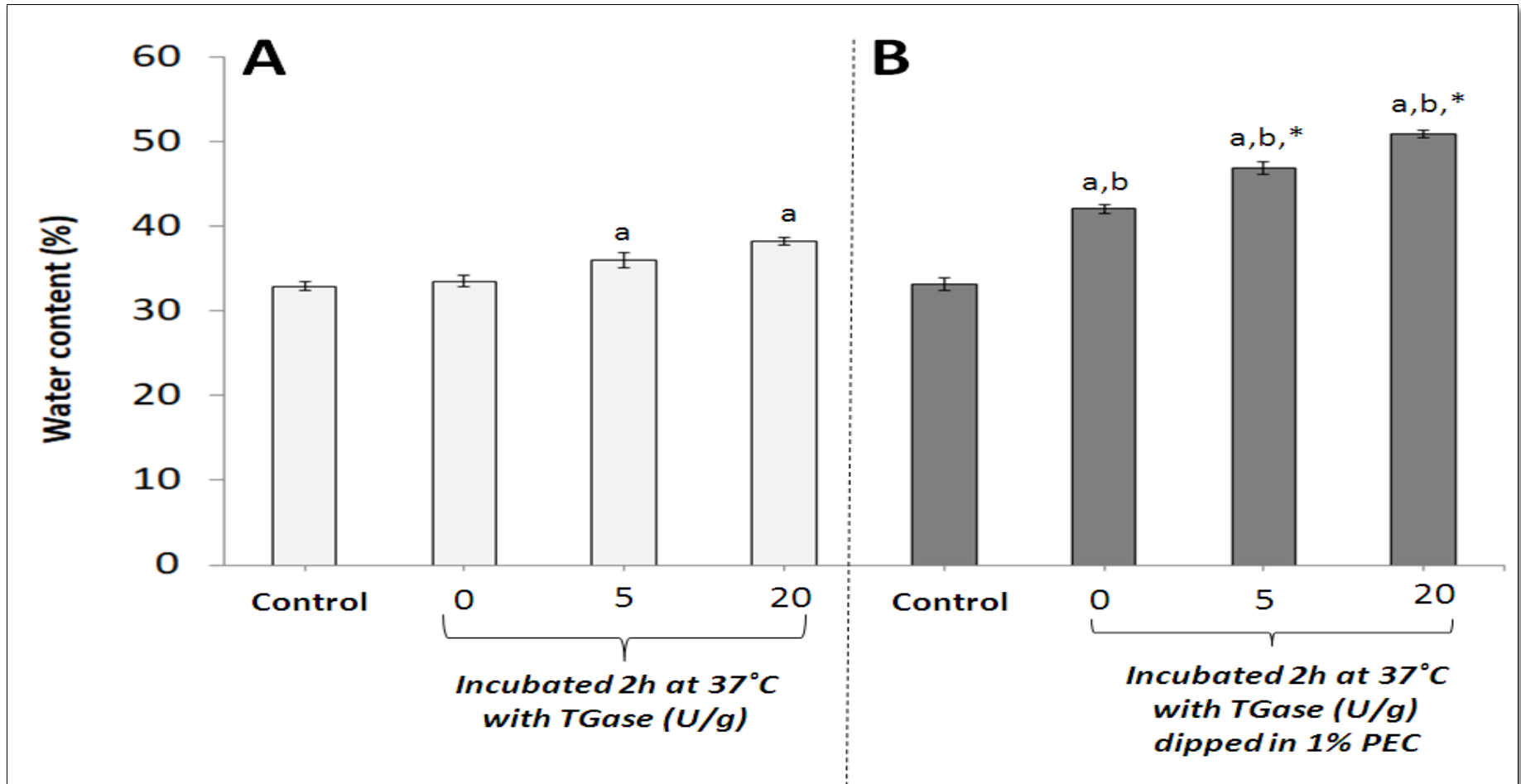
dipping into 1% PEC- based



Water content of fried falafel balls

without dipping

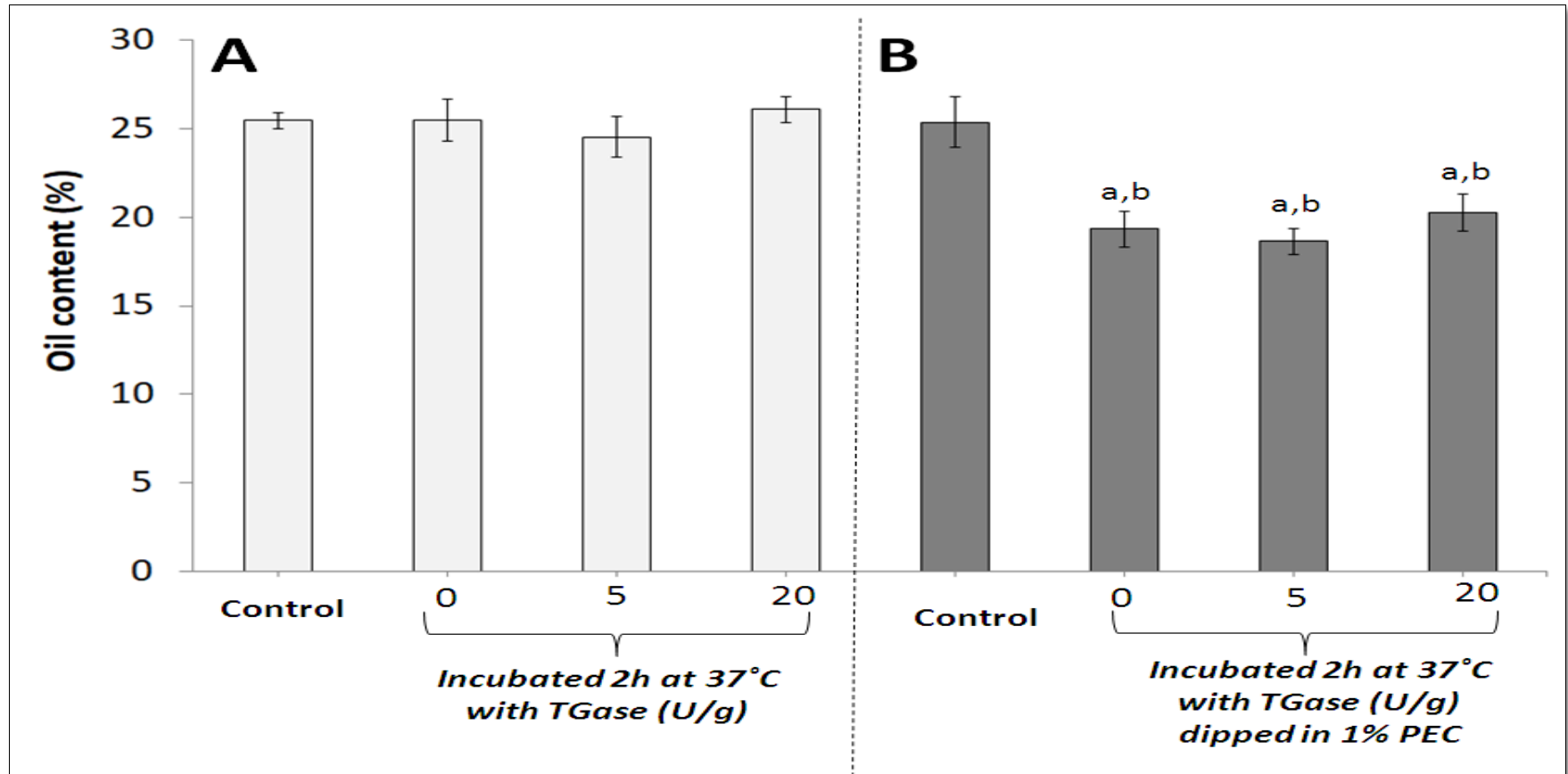
dipping into 1% PEC- based



Oil content of fried falafel balls

without dipping

dipping into 1% PEC- based



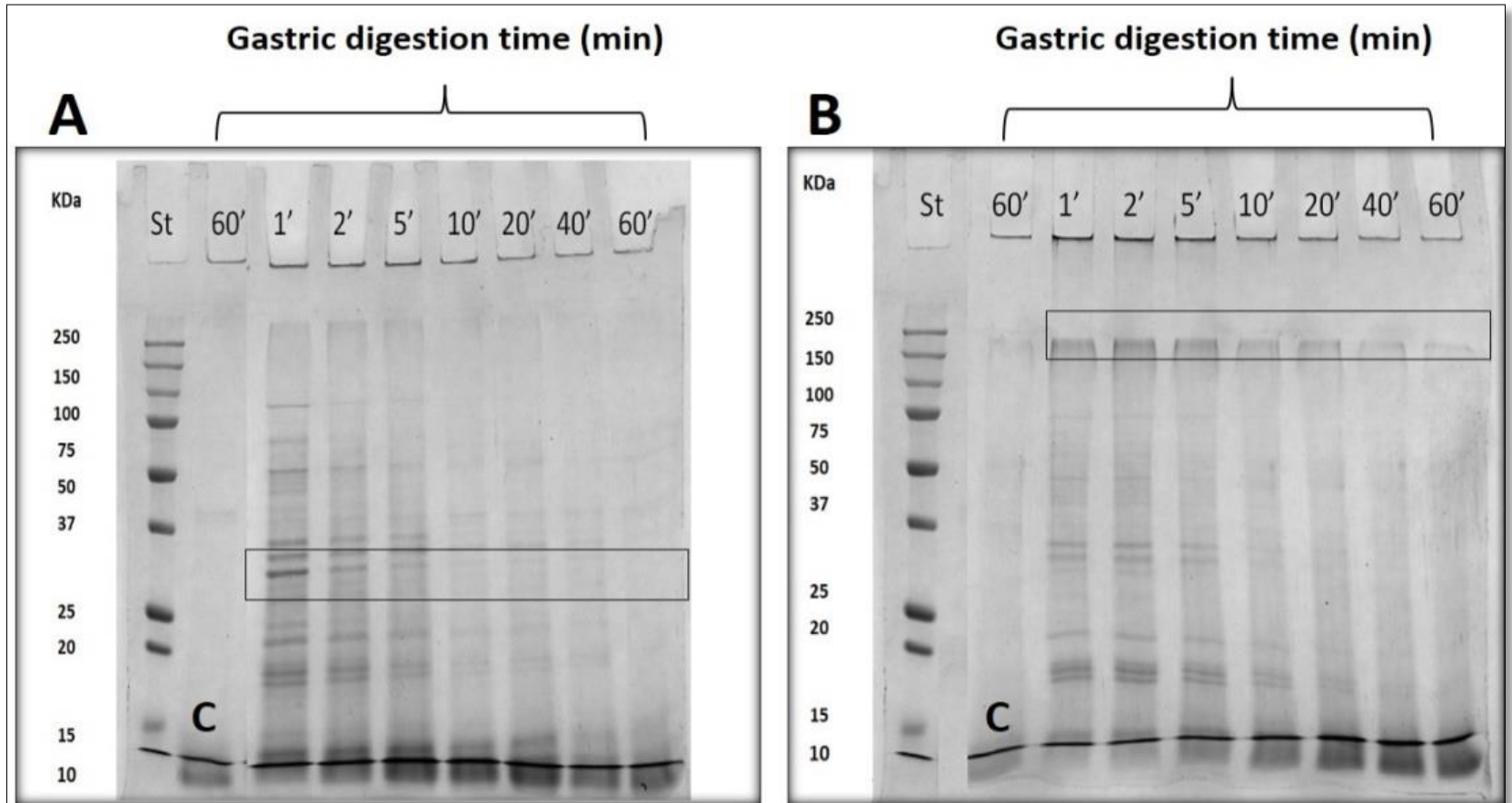
Texture Profile Analysis (TPA) of falafel balls

Falafel type	Hardness (N)	Chewiness (N.mm)	Gumminess (N)
<i>Traditional falafel</i>	56.41 ± 5.50	184.28 ± 3.10	23.20 ± 1.20
<i>without TGase</i>	52.22 ± 5.30	180.97 ± 2.80	22.15 ± 1.20
<i>+ TGase 5U/g</i>	70.88 ± 3.25 ^a	238.44 ± 2.70 ^a	38.87 ± 1.50 ^a
<i>+ TGase 20U/g</i>	96.57 ± 4.80 ^a	280.25 ± 15.10 ^a	49.64 ± 3.80 ^a
<i>Dipped in water</i>	52.18 ± 3.40	178.13 ± 4.10	21.42 ± 3.01
<i>Dipped in 1% PEC</i>	58.13 ± 4.90	183.23 ± 11.69	23.29 ± 4.50
<i>+TGase (5U/g) and dipped in 1% PEC</i>	114.31 ± 8.20 ^{a,b}	453.18 ± 11.30 ^{a,b}	67.60 ± 4.50 ^{a,b}
<i>+ TGase (20U/g) and dipped in 1% PEC</i>	136.07 ± 12.28 ^{a,b}	518.50 ± 18.05 ^{a,b}	78.24 ± 2.01 ^{a,b}

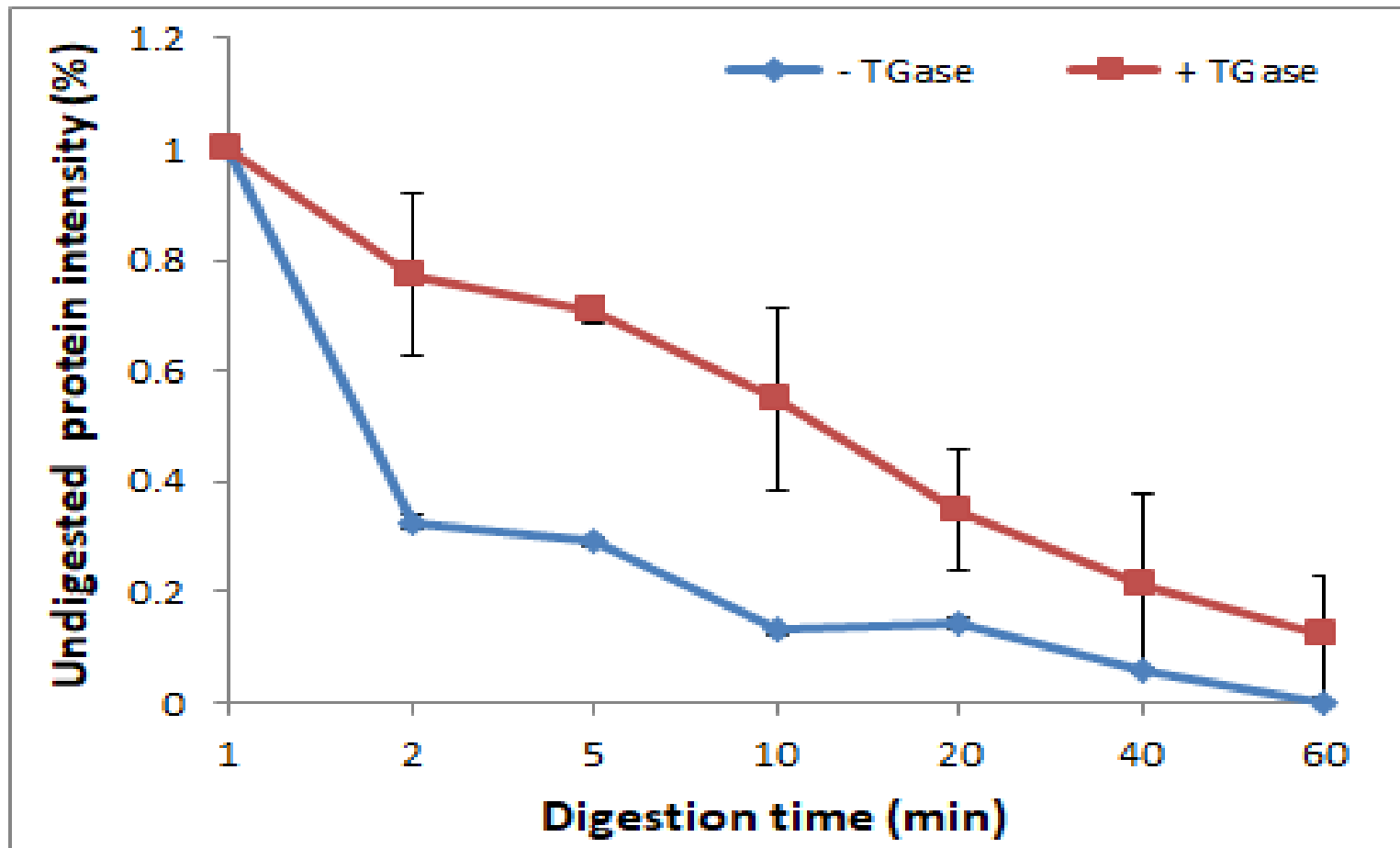
SDS- PAGE profile of falafel subjected to in vitro experiments

without TGase

with TGase (20 U/g)



Densitometry analysis of the SDS- PAGE bands



Conclusions

- ❑ TGase enzyme was able to reduce the ACR content of falafel balls, and this reduction was even more evident when TGase – prepared balls were coated by PEC, that was able to decrease the ACR concentration also in the falafel without TGase treatment.
- ❑ TGase also had an effect on the texture profile parameters. On the other hand, the PEC coating protection allowed to reduce the oil content of this food product, either treated or not by means of TGase.
- ❑ Protein gastric digestion carried out under physiological conditions showed that enzymatic treatment slightly decreased the digestion rate, although the proteins were fully digested in both unprocessed and TGase-processed system.

THANKS FOR ATTENTION!

