Impact of manufacture and digestion process of foods enriched with sesame flour on the antioxidant response of human hepatocyte in vitro

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Founding sources

Background

Bioactive compounds in food such as polyphenols (PF) vary in structure, concentration, and action since the moment they are ingested until they reach the target organs. Even more, when immersed in a food matrix, their activity can be affected by the interactions with the remain components of food. Therefore, regarding polyphenols incorporation into functional food formulation, it result relevant to define the repercussion on the biological activities not only of food matrix interaction and manufacturing processes, but also the impact of each digestion steps involved in ingestion. Simulated gastric, intestinal and colonic digestion allows the estimation of changes in the effective PF activity present in food. Here, a sweet wheat cookie formulation snack made with 10% substitution of defatted sesame flour (DSF) was used as a model of plausible functional food enriched in PF and it bioactivity was evaluated in a cellular system.

Aim

To evaluate the impact of both manufacturing and digestion procedures of foods enriched with defatted sesame flour over the effective biological action on the cellular redox state.

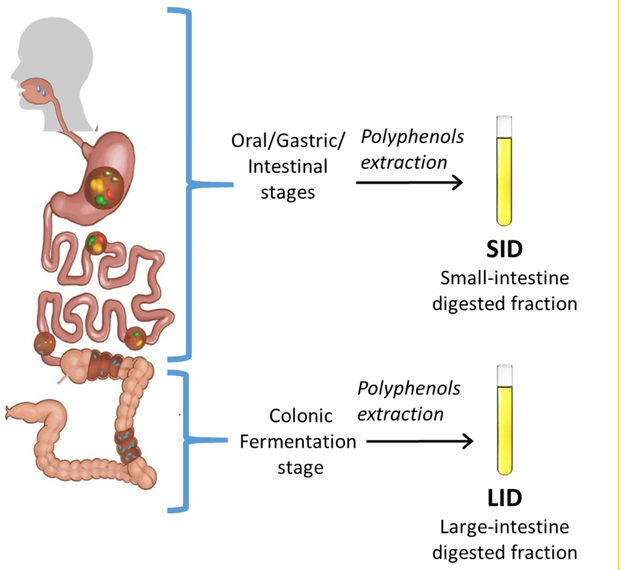
Mat & Meth

A model snack food enriched in polyphenosl was used: sweet cookie with the addition of sesame flour (DSF). Polyphenolic extracts (methanol:water) were obtained from DSF, base cookies (no additives, CC), DSF-enriched cookie (SC). The cookies were processed by gastric/intestinal digestion (SID) and colonic fermentation (LID) in vitro, obtaining polyphenolic extracts for each digestion step. The HepG2 liver cell line was incubated with the aforementioned extracts (5ug/mL, 24h) and injured with H2O2 (10mM, 1h) to produce oxidative stress. To evaluate the effect of enriching foods with DSF and the impact of the digestion process on their biological action on the cellular redox state, the following were determined: the intracellular oxidative state and cell death by flow cytometry, the activity of antioxidant enzymes (Catalase (CAT), Glutathione Peroxidase (GPx) and Reductase (GR)) and glutathione (GSH) content, as well as protein and lipid oxidation by spectrophotometry. Statistics: ANOVA or MLGM, followed by Fisher Test (p>0.05). Different letters indicate statistical significance.

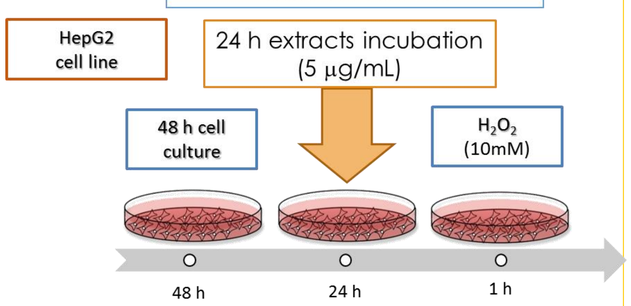
DEFATTED SESAME FLOUR EXTRACTS

ENRICHED FOOD MODEL

SIMULATED DIGESTION IN VITRO



CELLULAR CULTURE



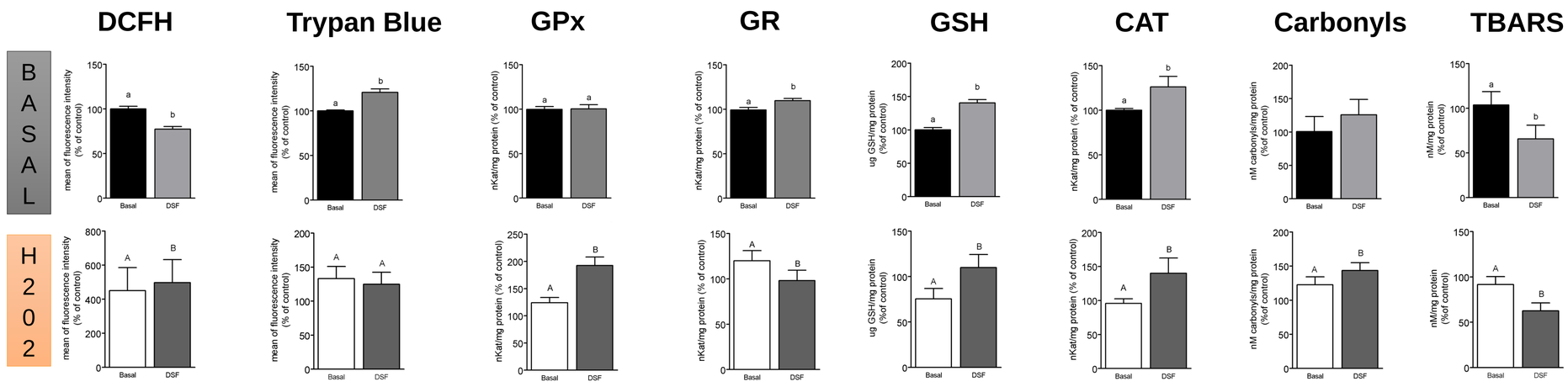
OUTPUT PARAMETERS

- **Flow Cytometry**
  - Intracellular oxidation state (DCFH-DA)
  - Cell Death (Trypan Blue)
- **Spectrophotometry**
  - Glutathione peroxidase (GPx)
  - Glutathione Reductase (GR)
  - Catalase (Cat)
  - Glutathione (GSH)
- **Oxidative damage**
  - Protein oxidation (Carbonyls)
  - Lipid oxidation (TBARS)

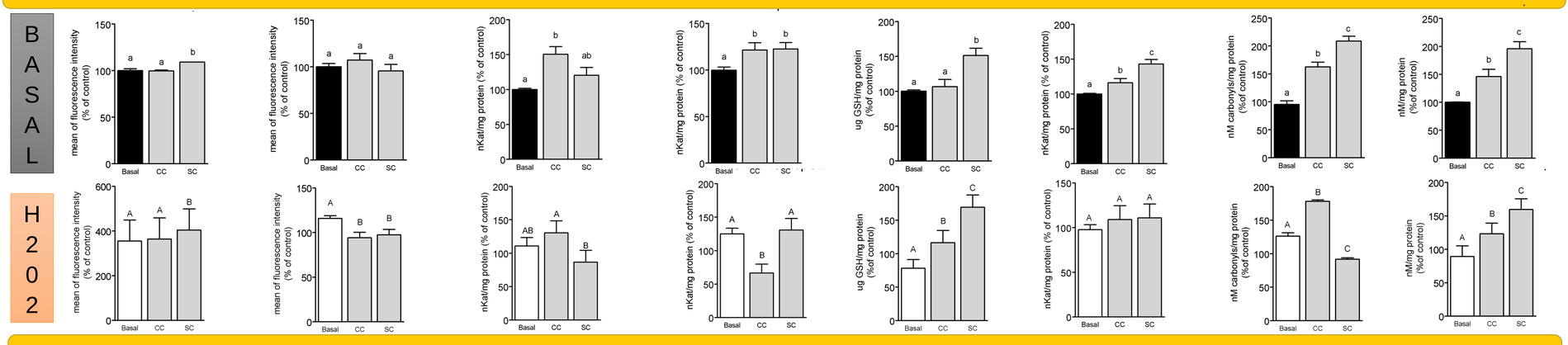
RESULTS

Oxidative state | Cell death | Antioxidant response | Oxidative damage

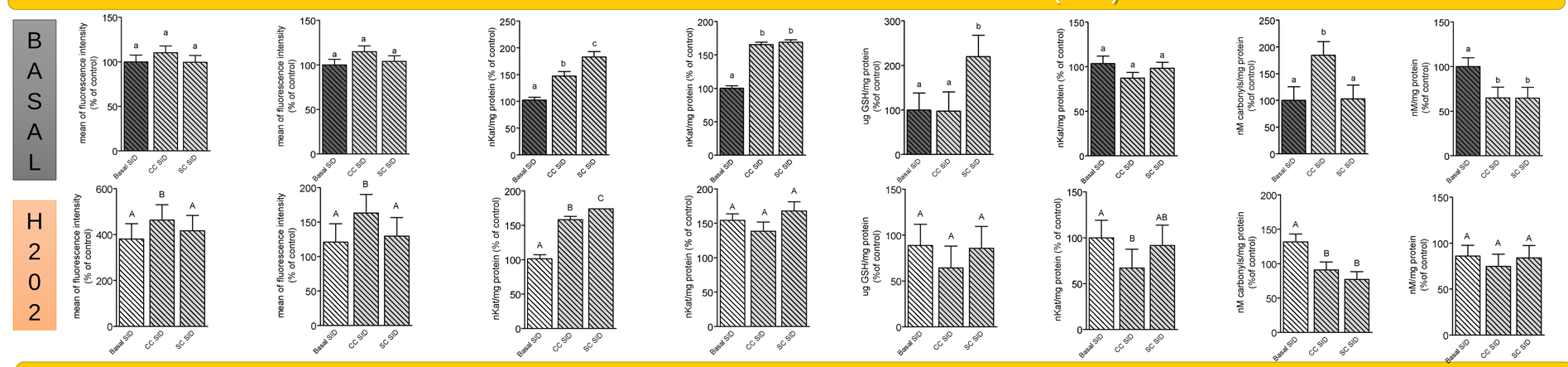
Defatted Sesame Flour Model (DSF)



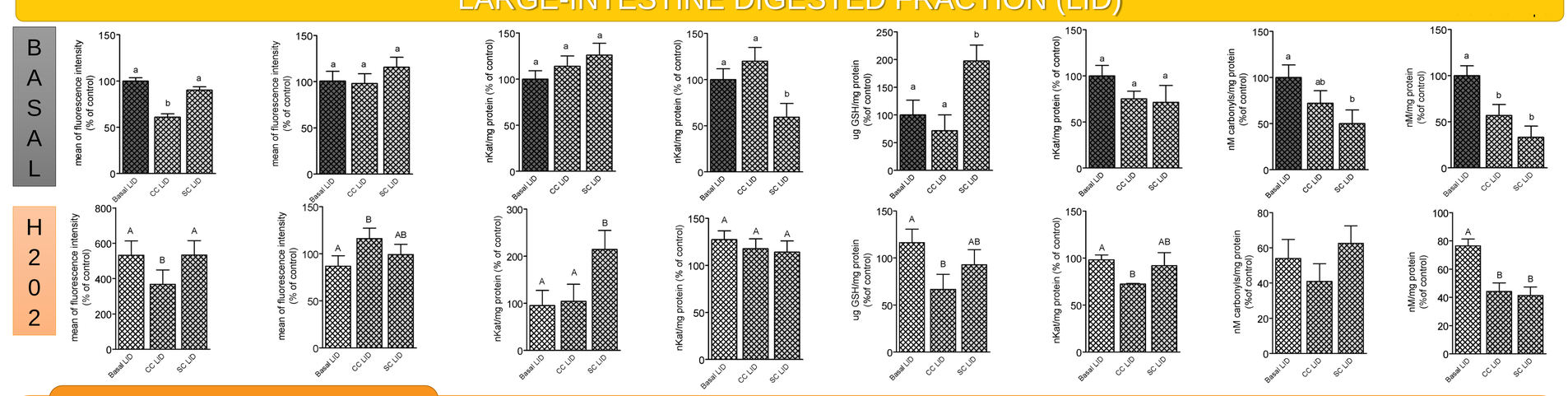
DSF ENRICHED FOOD MODEL



SMALL-INTESTINE DIGESTED FRACTION (SID)



LARGE-INTESTINE DIGESTED FRACTION (LID)



Conclusions

- DSF may be considered for functional incorporation in foods, since it may promote antioxidant response, providing preventive benefits and protective action in an oxidative damage context.
- The biological actions of DSF enrichment in relation to the cellular redox state vary depending on the food matrix and its degree of digestion.
- The detected effects of DSF extracts in all evaluated conditions are mainly grouped around impacts in GSH levels and its cycling enzymes activities, as well as lipid oxidation, suggesting that this would be one of the mechanisms of actions of DSF active compounds.