

# SISSG EDIBLE FATS AND OILS INNOVATION and SUSTAINABILITY IN PRODUCTION AND CONTROL

Perugia, June 15<sup>th</sup>-17<sup>th</sup>, 2022



## Durum wheat: a sustainable germ

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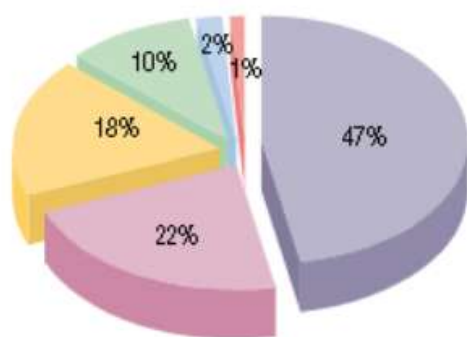


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# Production and uses of durum wheat



Durum wheat production  
in the main EU countries

Italia  
Spagna  
Francia  
Grecia  
Portogallo  
Austria



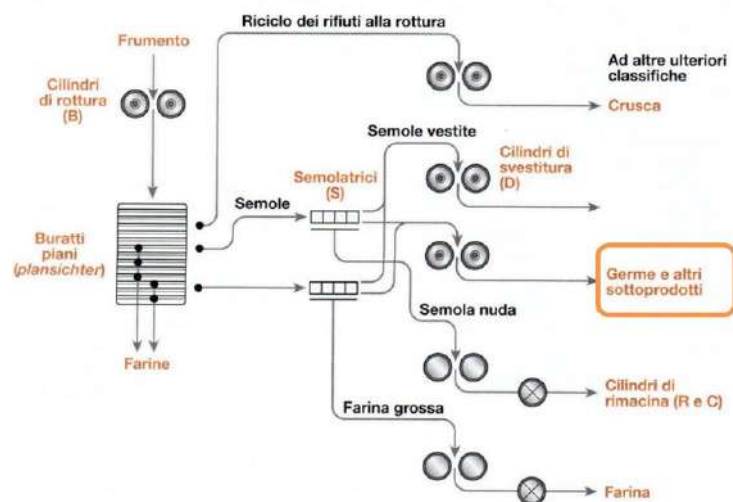
The first Italian region  
for production is Apulia



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# Production and uses of durum wheat



  
Durum wheat flour

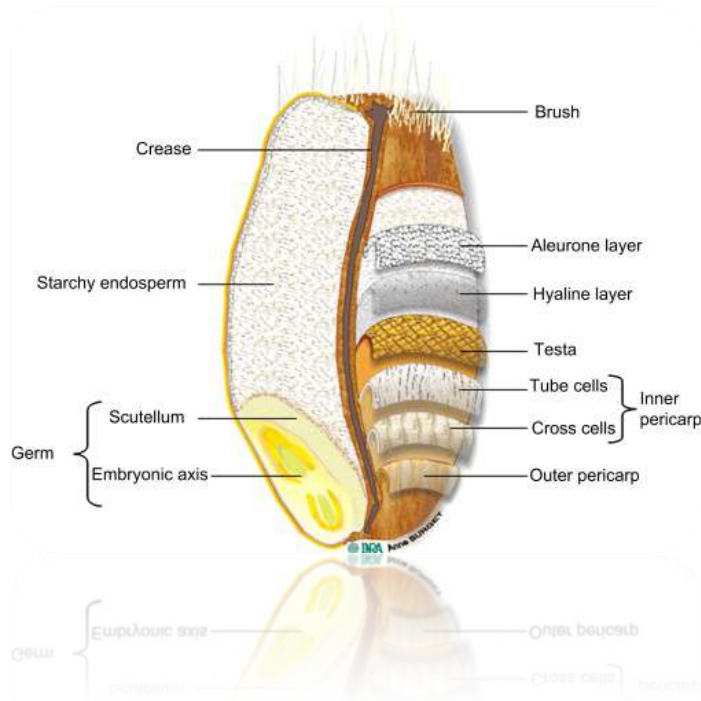


  
By-products





# Durum wheat by-product composition



2–3% Germ

25% Bran

Essential fatty acids

Tocotrienols and tocopherols

Carotenoid



# Durum wheat by-product characterization

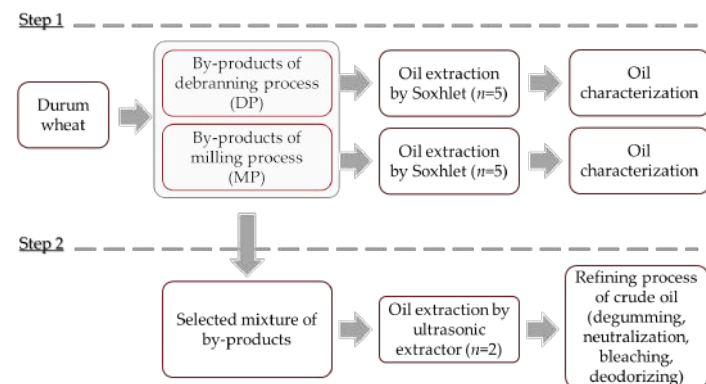
## First Aim



Characterize the oils obtained from two different durum wheat by-products (STEP 1)



Evaluate the changes after the oil refining process (STEP 2)



Article

## Characterization and Effect of Refining on the Oil Extracted from Durum Wheat By-Products

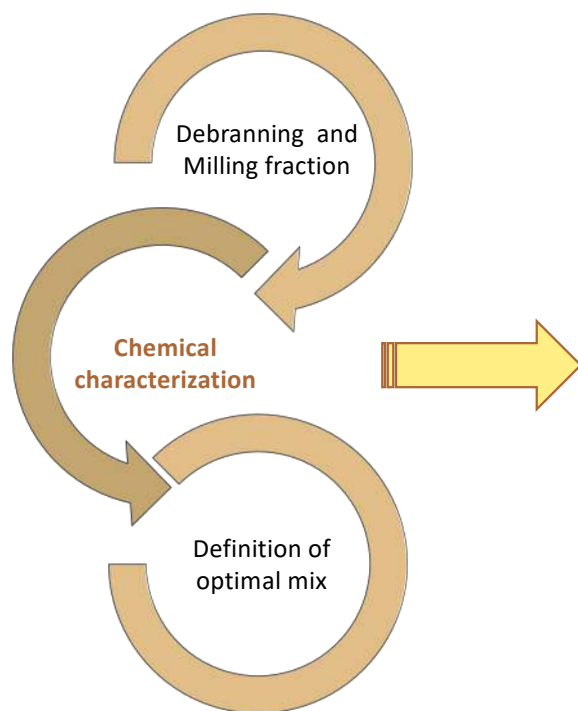
Giacomo Squeo <sup>1</sup>, Roccangelo Silletti <sup>1</sup>, Giulia Napoletano <sup>2</sup>, Marcello Greco Miani <sup>2</sup>, Graziana Difonzo <sup>1</sup>, Antonella Pasqualone <sup>1</sup> and Francesco Caponio <sup>1,\*</sup>



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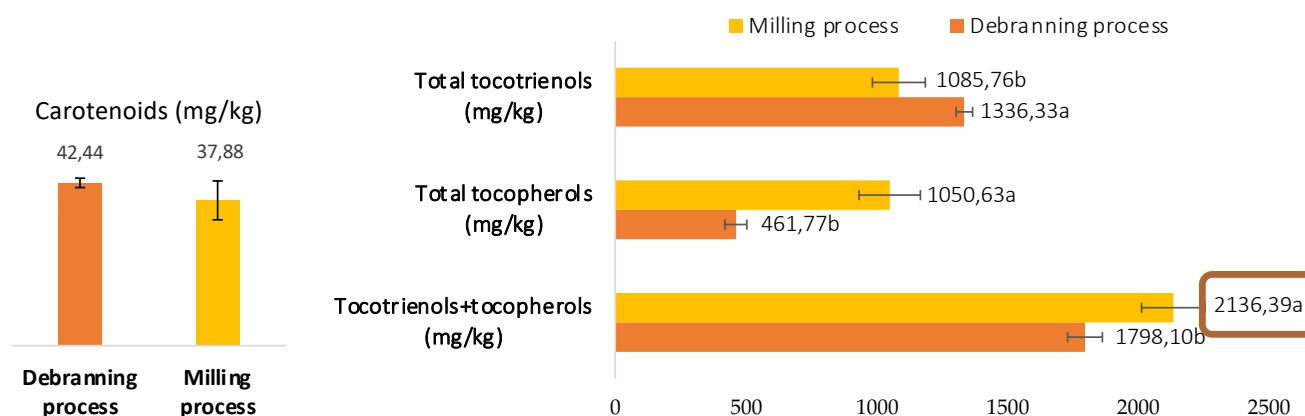
# Durum wheat by-product characterization



Fraction	Oil content
Debranning	6.0% ( $\pm 0.3\%$ )a
Milling	4.8% ( $\pm 0.4\%$ )b

Fatty acids (%)	Debranning process	Milling process
SFA	17.28 $\pm$ 0.51b	18.67 $\pm$ 0.37a
MUFA	21.01 $\pm$ 0.52a	18.86 $\pm$ 1.81b
PUFA	61.71 $\pm$ 0.12	62.46 $\pm$ 1.51

Different letters in rows indicate significant differences ( $p \leq 0.05$ ).



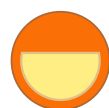
# Durum wheat oil characterization after refining



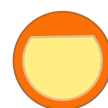
Extraction



Degumming



Neutralization



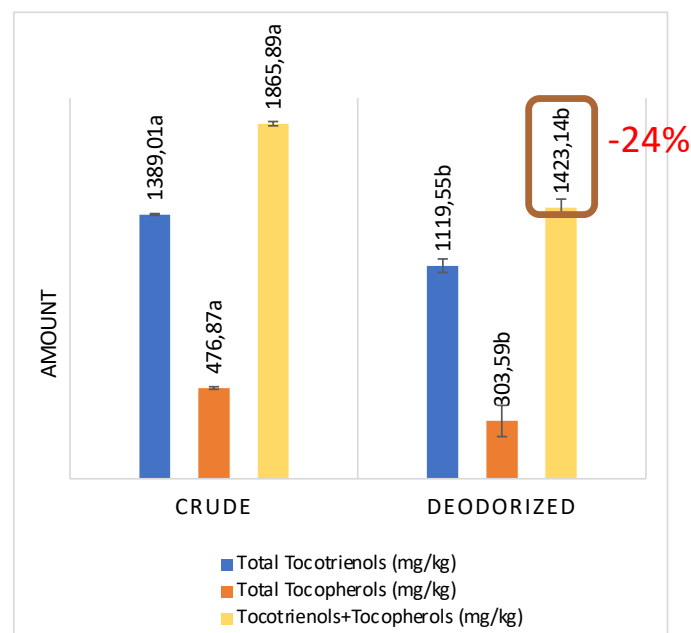
Blanching



Deodoration

Parameters	Crude oil	Deodorized oil
FFA (%)	11.58 ± 0.31a	0.32 ± 0.04b
PV (meq O <sub>2</sub> /kg)	4.45 ± 0.65a	2.05 ± 0.07b
TAGP (%)	0.14 ± 0.02b	0.41 ± 0.01a
ox-TAG (%)	2.28 ± 0.22a	1.58 ± 0.06b
DAG (%)	5.34 ± 0.25a	5.09 ± 0.09a
PCs (%)	19.34 ± 0.15a	7.39 ± 0.13b

FFA, free fatty acids; PV, peroxide value; TAGP, triacylglycerol oligopolymers; ox-TAG, oxidized triacylglycerols; DAG, diacylglycerols; PCs, polar compounds. Different letters in rows indicate significant differences (p ≤ 0.05).



Total sterols (mg/kg)	Total policosanols (mg/kg)
20975	754



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# Durum wheat oil valorization

## Second Aim



Evaluate the chemical and physical characteristics of foods after processing



Evaluate the sensory properties of foods after processing



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# Biscuits with durum wheat oil



Formulation of the experimental biscuits. C = Biscuits prepared with 100% sunflower oil; D50 = biscuits prepared with sunflower oil (50%) and durum wheat oil (50%); D100 = biscuits prepared with 100% durum wheat oil.

Ingredients	C (g)	D50 (g)	D100 (g)
Wheat flour	400	400	400
Sunflower oil	112	56	–
Durum wheat oil	–	56	112
Sugar	112	112	112
Partially skimmed milk	128	128	128
Baking powder	4.8	4.8	4.8



Article

## Effect of Durum Wheat Oil on the Physico-Chemical and Sensory Features of Biscuits

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## Characterization of biscuits with durum wheat oil

- ✓ Resistance to Oxidation
- ✓ Tocopherols and Tocotrienols
- ✓ Polar Compounds of the Lipid Fraction
- ✓ Volatile Compounds



- ✓ Texture Profile Analysis
- ✓ Color Measurement



- ✓ Sensory Properties



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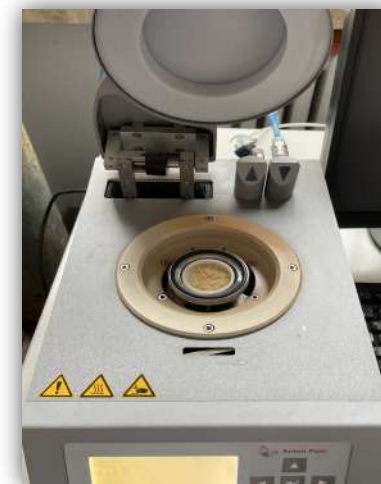




## Chemical characterization of biscuits with durum wheat oil

Sample	Tocopherols (mg/kg)	Tocotrienols (mg/kg)
<b>Oils</b>		
Sunflower oil	677.9 ± 7.1 <sup>a</sup>	7.4 ± 1.4 <sup>b</sup>
Durum wheat oil	305.6 ± 7.6 <sup>b</sup>	1119.6 ± 19.5 <sup>a</sup>
<b>Biscuits</b>		
C	601.8 ± 10.1 <sup>a</sup>	64.1 ± 11.8 <sup>c</sup>
D50	418.9 ± 11.1 <sup>b</sup>	635.2 ± 38.7 <sup>b</sup>
D100	280.6 ± 8.3 <sup>c</sup>	982.9 ± 11.2 <sup>a</sup>

Sample	Induction Time (h)
<b>Oils</b>	
Sunflower oil	31.50 ± 0.42 <sup>b</sup>
Durum wheat oil	39.80 ± 0.09 <sup>a</sup>
<b>Biscuits</b>	
C	53.61 ± 1.87 <sup>c</sup>
D50	70.87 ± 2.94 <sup>b</sup>
D100	79.92 ± 2.21 <sup>a</sup>



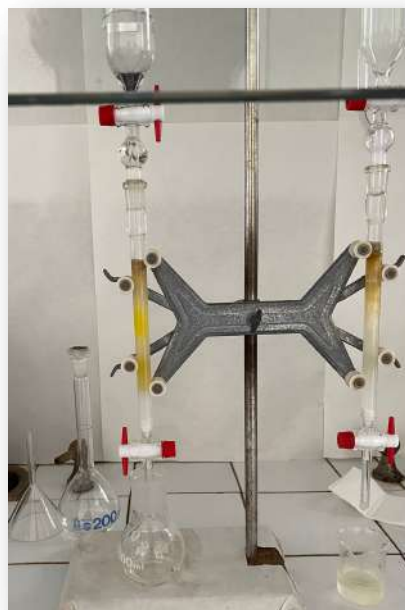
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## Chemical characterization of biscuits with durum wheat oil

Volatile Compounds (µg/g)	Sample Type		
	C	D50	D100
<b>Aldehydes</b>			
Hexanal	40.88 ± 0.49 <sup>a</sup>	33.53 ± 0.26 <sup>b</sup>	25.97 ± 1.06 <sup>c</sup>
Hexenal	5.38 ± 0.35 <sup>a</sup>	2.20 ± 0.11 <sup>b</sup>	2.52 ± 0.31 <sup>b</sup>
2-Heptenal	4.69 ± 0.17 <sup>a</sup>	2.83 ± 0.03 <sup>b</sup>	0.42 ± 0.16 <sup>c</sup>
Nonanal	11.83 ± 0.61 <sup>a</sup>	6.36 ± 0.36 <sup>b</sup>	6.38 ± 0.22 <sup>b</sup>
2-Methylbutanal	10.26 ± 0.23 <sup>b</sup>	13.92 ± 1.42 <sup>a</sup>	16.88 ± 0.41 <sup>a</sup>
3-Methylbutanal	17.71 ± 0.86 <sup>b</sup>	25.41 ± 0.77 <sup>a</sup>	27.03 ± 0.89 <sup>a</sup>
Benzaldehyde	4.85 ± 0.38 <sup>b</sup>	7.12 ± 0.92 <sup>a</sup>	7.24 ± 0.15 <sup>a</sup>
<b>Furan compounds</b>			
2-Furanmethanol	4.60 ± 0.51 <sup>b</sup>	8.78 ± 0.74 <sup>a</sup>	9.95 ± 0.68 <sup>a</sup>
2-Furancarboxaldehyde (furfural)	3.67 ± 0.25 <sup>b</sup>	5.41 ± 1.99 <sup>ab</sup>	8.60 ± 0.44 <sup>a</sup>
<b>Pyrazines</b>			
Pyrazine	8.27 ± 1.19 <sup>b</sup>	13.10 ± 0.13 <sup>a</sup>	13.15 ± 0.20 <sup>a</sup>
Methyl-pyrazine	30.79 ± 1.31 <sup>b</sup>	30.90 ± 1.82 <sup>b</sup>	44.19 ± 1.71 <sup>a</sup>
Ethyl-pyrazine	7.08 ± 1.21 <sup>b</sup>	6.15 ± 0.48 <sup>b</sup>	10.53 ± 0.17 <sup>a</sup>



Polar Compound (%)	Sample Type		
	C	D50	D100
TAGP	0.43 ± 0.03 <sup>a</sup>	0.31 ± 0.02 <sup>b</sup>	0.17 ± 0.02 <sup>c</sup>
ox-TAG	3.52 ± 0.13 <sup>a</sup>	2.63 ± 0.43 <sup>b</sup>	1.81 ± 0.19 <sup>b</sup>
DG	1.30 ± 0.02 <sup>c</sup>	3.03 ± 0.05 <sup>b</sup>	4.93 ± 0.17 <sup>a</sup>



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## Physical characterization of biscuits with durum wheat oil

### ✓ Color Measurement

The different oil did not change the color



All biscuits showed a similar golden-brown color



### ✓ Texture Profile Analysis - Three-point bending test

Diacylglycerols of durum wheat oil positively influence the **Breakability**





## Sensory properties of biscuits with durum wheat oil

### QUANTITATIVE DESCRIPTIVE ANALYSIS (QDA) OF BISCUITS

Sample \_\_\_\_\_

#### VISUAL-TACTILE CHARACTERISTICS

Porosity \_\_\_\_\_

Breakability \_\_\_\_\_

#### ODOR NOTES

Caramel \_\_\_\_\_

Oxidized oil \_\_\_\_\_

Shortbread \_\_\_\_\_

	Similar	Different
Porosity		
Typical shortbread odor		
Caramel odor		
No oxidized oil odor		
More pronounced breakability		



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# Focaccia with durum wheat oil



Positive effects on texture parameters, color and sensorial properties



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European federation for the science and technology of lipids



Prof. Francesco CAPONIO



UNIVERSITÀ  
DEGLI STUDI DI BARI  
ALDO MORO



# Conclusions



**PUFA**

**Antioxidant**

**Phytosterols**







Thank you!



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