NON-ALCOHOLIC WINES: EVALUATION OF CHEMICAL PROFILE AND BIOLOGICAL PROPERTIES

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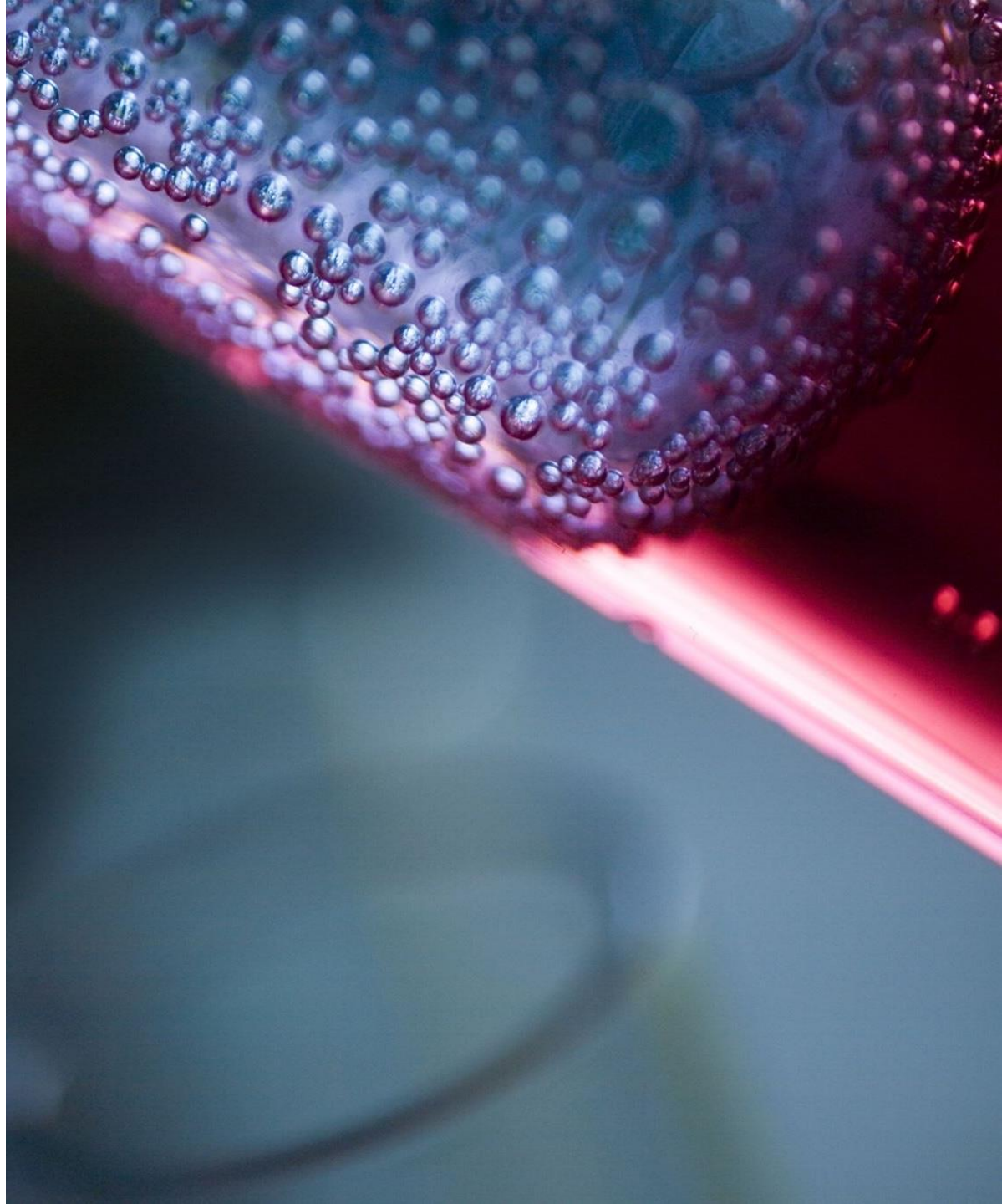
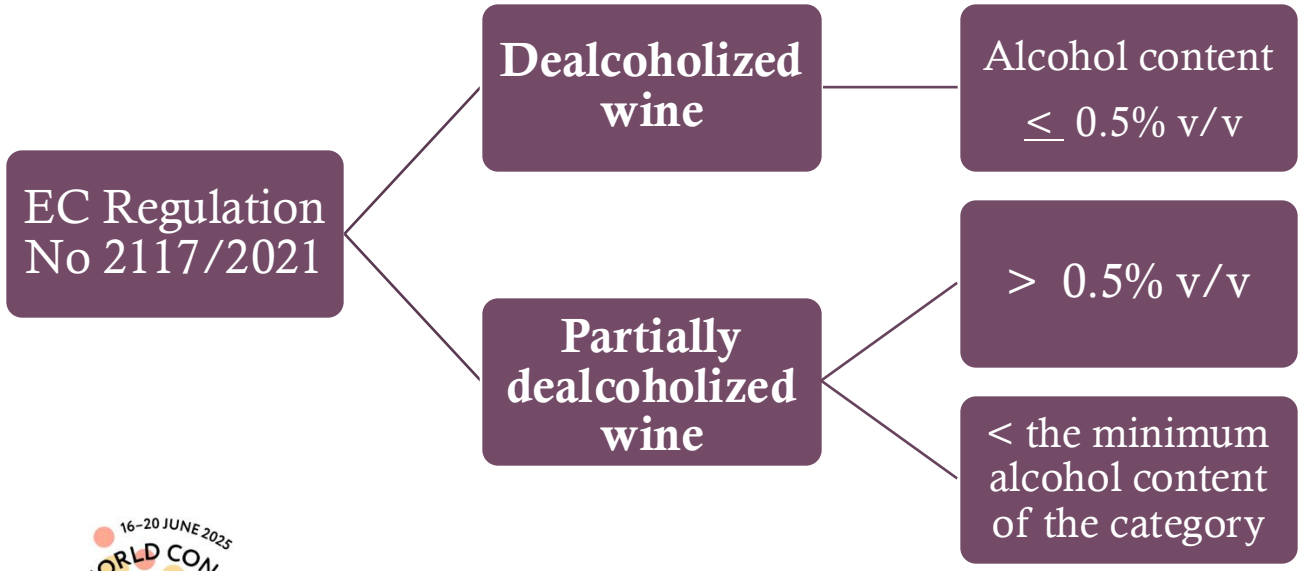


LOW AND ZERO ALCOHOL WINES

EU proposal (March 2025)



«Alcohol free wines»
≤ 0.5%

«0.0 % wines»
≤ 0.05%

Alcohol light wines
> 0.5% but 30% lower than the minimum alcohol content of the category

16–20 JUNE 2025
46TH WORLD CONGRESS OF VINE AND WINE
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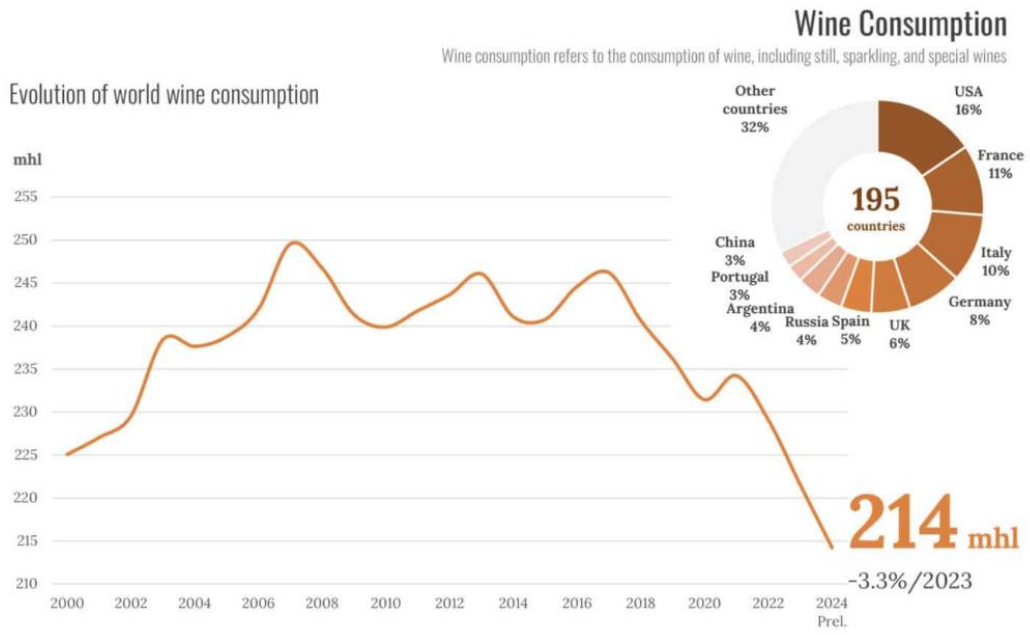
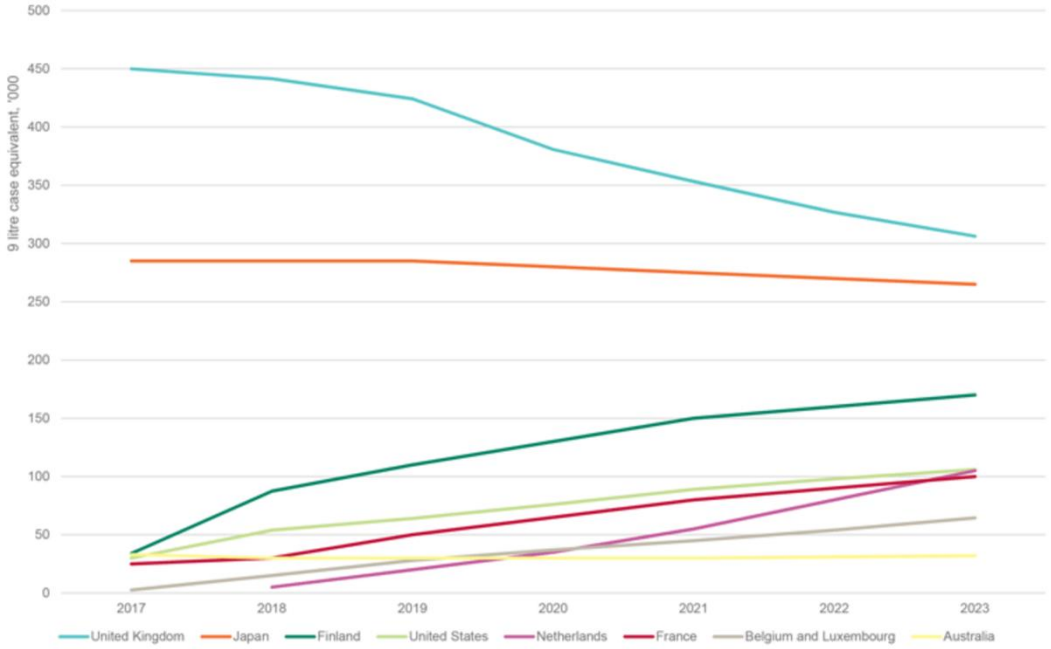
GLOBAL CONSUMPTION OF WINE VS NO-ALCOHOL WINES

Wine consumption (OIV, 2025)

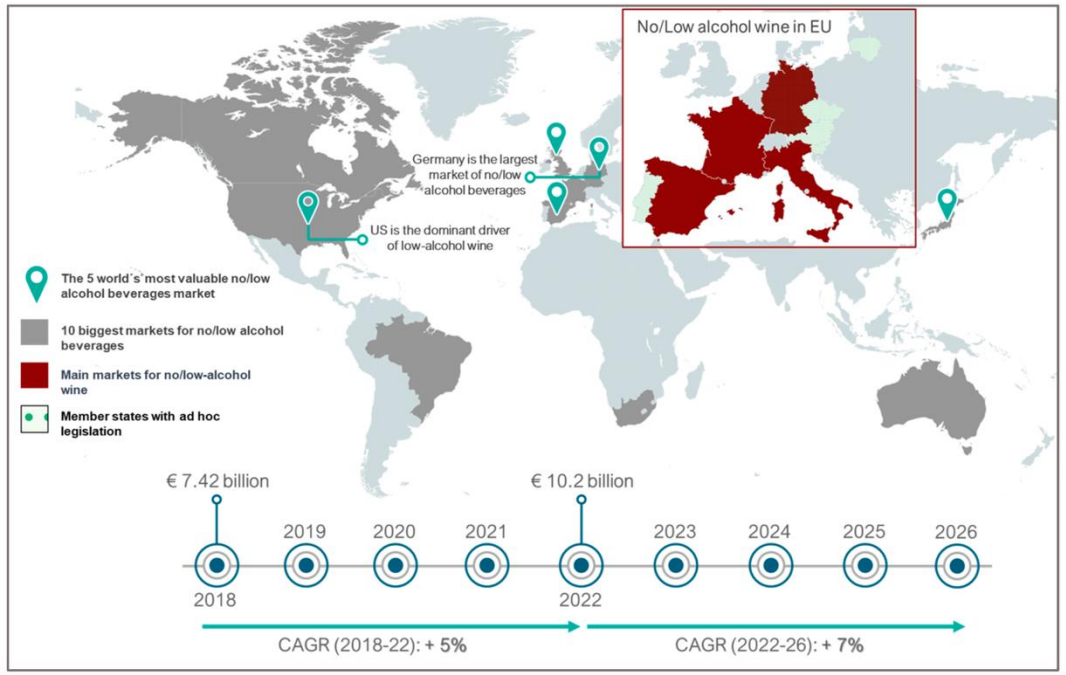


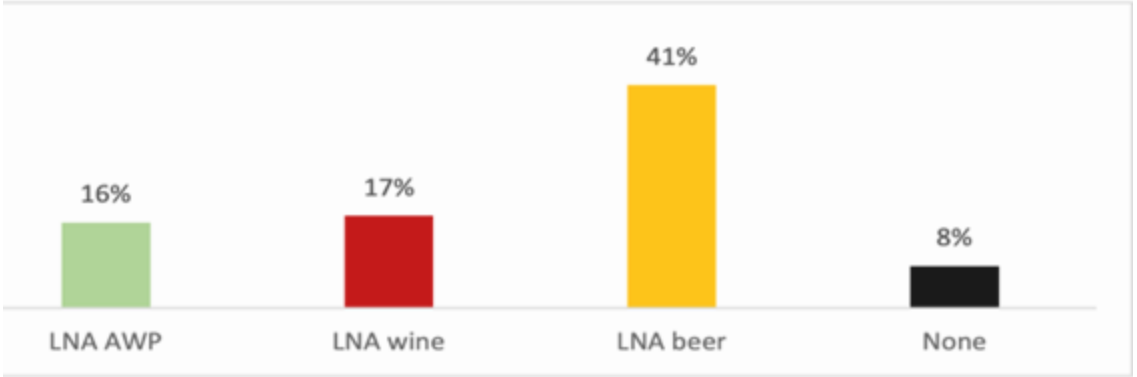
Low and zero alcohol wine consumption

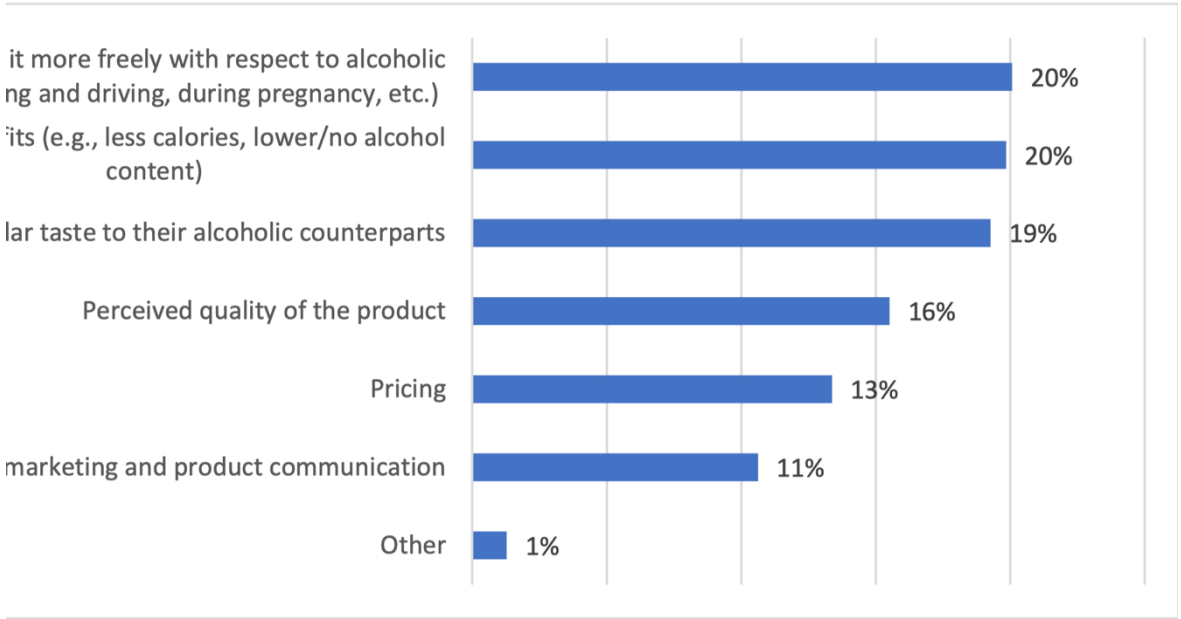


Source: The IWSR

GLOBAL NON ALCOHOLIC WINE MARKET





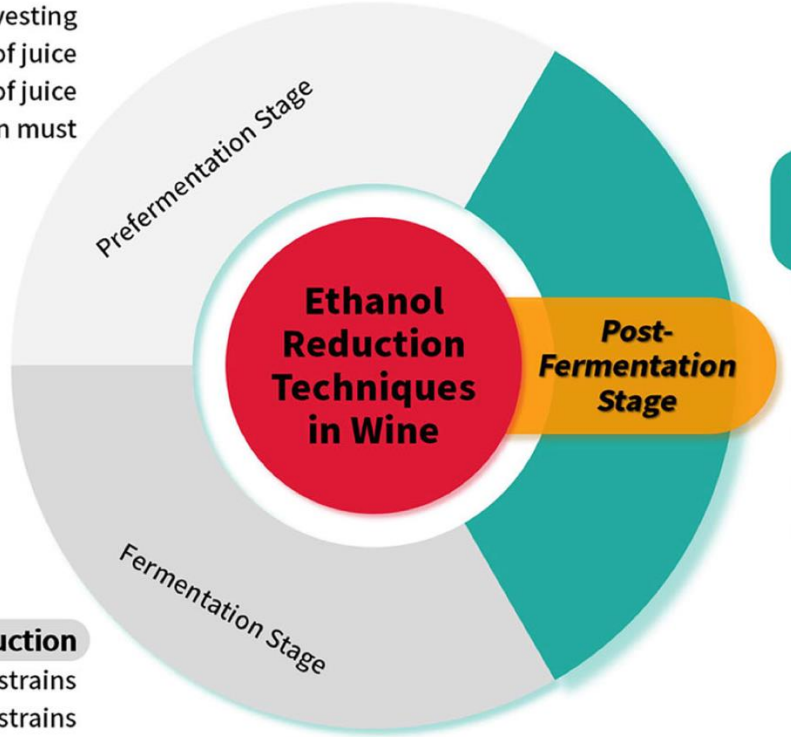


EU consumers attitude towards dealcoholized beverages

European Commission: Directorate-General for Agriculture and Rural Development https://data.europa.eu/doi/10.2762/315469

TECHNIQUES FOR REDUCING OR REMOVING ALCOHOL

Reduction of Fermentable Sugar
- Viticulture practices
- Early harvesting
- Dilution of juice
- Membrane filtration of juice
- Addition of Glucose Oxidase enzyme in must



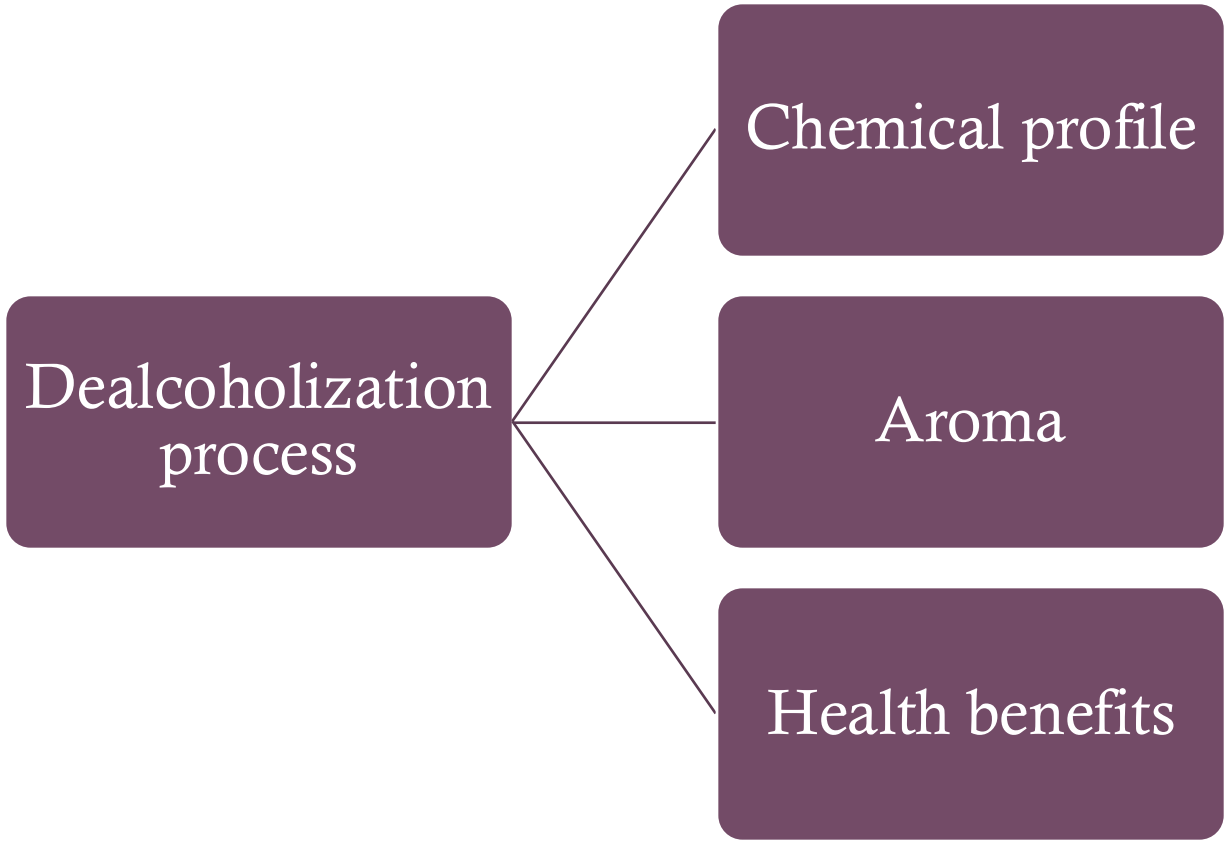
Technologies to Reduce Alcohol
- Reverse osmosis
- Osmotic distillation
- Vacuum distillation
- Spinning cone column
- Pervaporation
- Diafiltration

Allowed by EU Regulation 2117/2021

Reduction of Alcohol Production
- Using non *S. cerevisiea* strains
- Using modified yeast strains
- Biomass reduction
- Arrested fermentation

Akhtar et al., 2025

MAIN CHALLENGES



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STUDY ROADMAP

1° step (2024)

- Analysis of the literature related on the available data on chemical profile and health benefits of dealcoholized wines

2° step (2025)

- Collection of zero alcohol wines on Italian market
- Chemical analysis
- Antioxidant and anti-inflammatory activities
- Panel test among italian consumers

3° step (2025)

- Sperimental dealcoholization of wines made from the same varieties of commercial dealcoholized wines (ongoing)

MATERIALS

Collection of zero alcohol wines on Italian market

Four dealcoholized wines from the Natureo line (Torres, Spain):

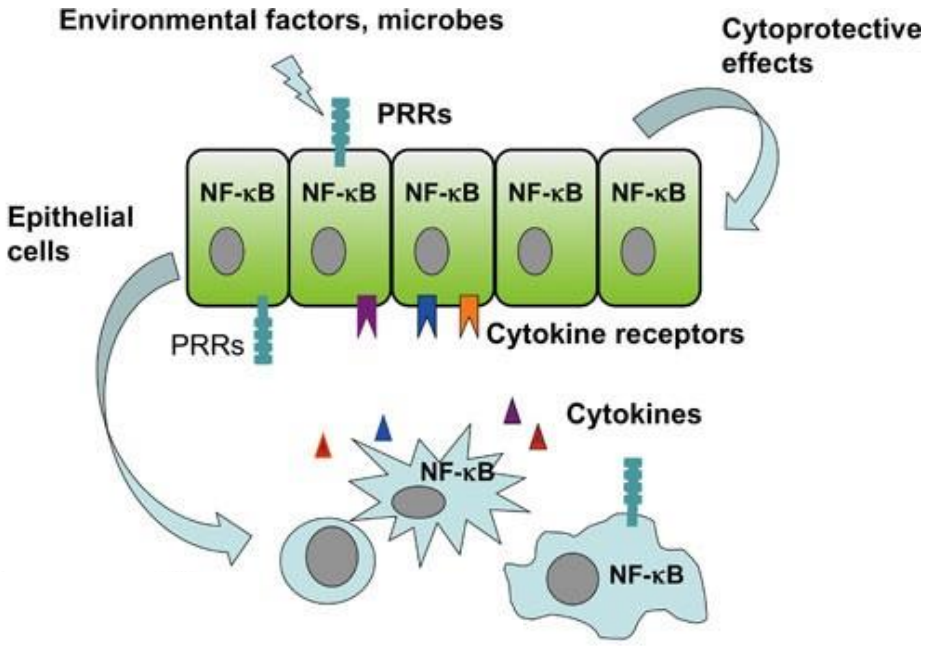
- **white wine** made from Muscat of Alexandria
- **rosé wine** made from Cabernet Sauvignon and Syrah
- **red wine** made from Syrah and Grenache
- **brut white sparkling wine** made from Muscat of Alexandria.

Chemical analysis

- Physico-chemical parameters
  - Total soluble solids (TSS)
  - pH
  - Titratable acidity (TA)
- Polyphenol profile
  - Total Polyphenol content (TPC)
  - Total flavonoids
  - Total anthocyanin content
- Scavenging capacity

Biological assays

- Cell line: GES-1
  Citotoxicity assay
- Measurement of IL-8 and IL-6 release
- Measurement of NF-kB-driven transcription



PANEL TEST

N. 31 untrained Italian students and academics to evaluate organoleptic properties (colour, taste and aroma) and overall appreciation of non-alcoholic wines.

Consumer panel	Age classes		Sex		Abstemoius	
	18 - 35	*36 - 70*	*M*	*F*	*Yes*	*No*
	17	14	12	19	7	24

Scheda di Degustazione Bianco

Campione: ***Muscat of Alexandria***

Nome Assaggiatore: _____
Data: _____

Analisi Visiva

- **Intensità colore:** 1 2 3 4 5
- **Tonalità** (verde=1; aranciato=5): 1 2 3 4 5

Analisi Olfattiva

- **Intensità:** 1 2 3 4 5
- **Floreale:** 1 2 3 4 5
  (es. gelsomino, camomilla, fiori d'arancio)
- **Frutta bianca:** 1 2 3 4 5
  (es. albicocca, pesca, mela, pera)
- **Frutta tropicale:** 1 2 3 4 5
  (es. ananas, melone, banana)
- **Frutta secca:** 1 2 3 4 5
  (es noci, nocciole, mandorla)
- **Agrumato:** 1 2 3 4 5
  (es. pompelmo, limone)
- **Vegetale:** 1 2 3 4 5
  (es. fieno, erba tagliata)
- **Speziato:** 1 2 3 4 5
  (es. noce moscata, cannella)
- **Balsamico:** 1 2 3 4 5
  (es. mentolo, eucalipto)

Analisi Gustativa

- **Struttura:** 1 2 3 4 5
- **Dolcezza:** 1 2 3 4 5
- **Acidità:** 1 2 3 4 5
- **Amaro:** 1 2 3 4 5
- **Sapidità:** 1 2 3 4 5
- **Equilibrio:** 1 2 3 4 5
- **Persistenza:** 1 2 3 4 5

Note e Impressioni Generali

_____
_____

Customer test Vini Dealcolati

Nome e Cognome: _____
Data: _____

Campione: _____

Aspettative ed esperienza

- Prima di assaggiare, ti aspettavi che il vino dealcolato fosse:
  ☐ Simile a un vino tradizionale ☐ Diverso ☐ Non avevo aspettative
- Dopo l'assaggio, ritieni che il vino abbia soddisfatto le tue aspettative?
  ☐ No ☐ In parte ☐ Sì
- Hai mai bevuto vino dealcolato prima? ☐ Sì ☐ No

Percezione della qualità e piacevolezza

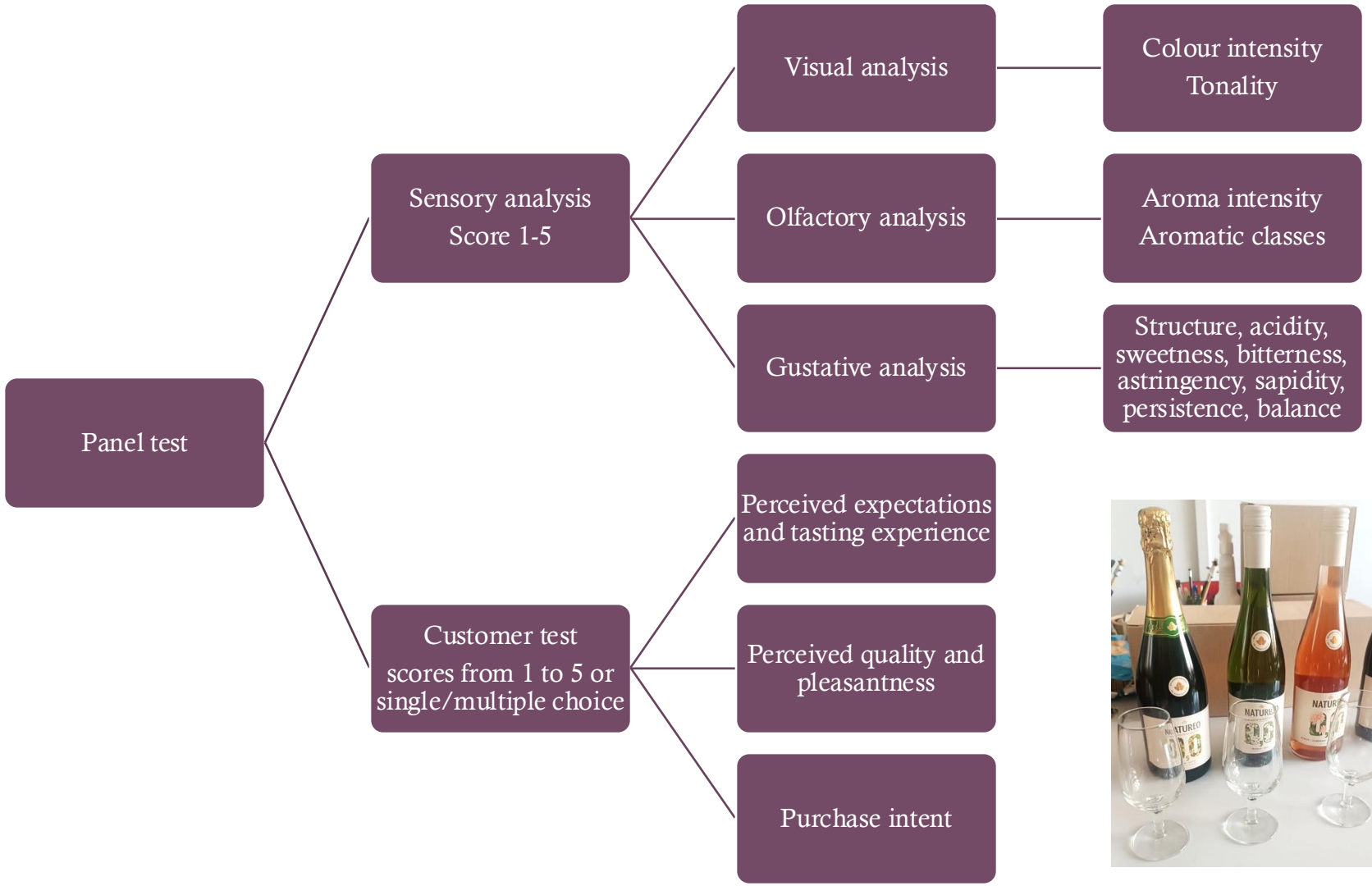
- Gradimento complessivo ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
- Lo percepisci come un prodotto di qualità? ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
- Lo considereresti una scelta valida per te o per amici? ☐ Sì ☐ No
- Se no, perché? _____

Disponibilità all'acquisto e occasioni di consumo

- Compreresti questo vino? ☐ Sì ☐ No ☐ Forse
- In quali occasioni lo berresti? (puoi selezionare più opzioni)
  ☐ Aperitivo ☐ Pasto ☐ Dopo cena ☐ Eventi speciali ☐ Altro: _____
- Lo consumeresti in alternativa al vino? ☐ Sì ☐ No ☐ Forse

7. Note e commenti liberi

_____
_____
_____
_____



Graphical and statistical analyses were performed using SPSS and jvenn web tool

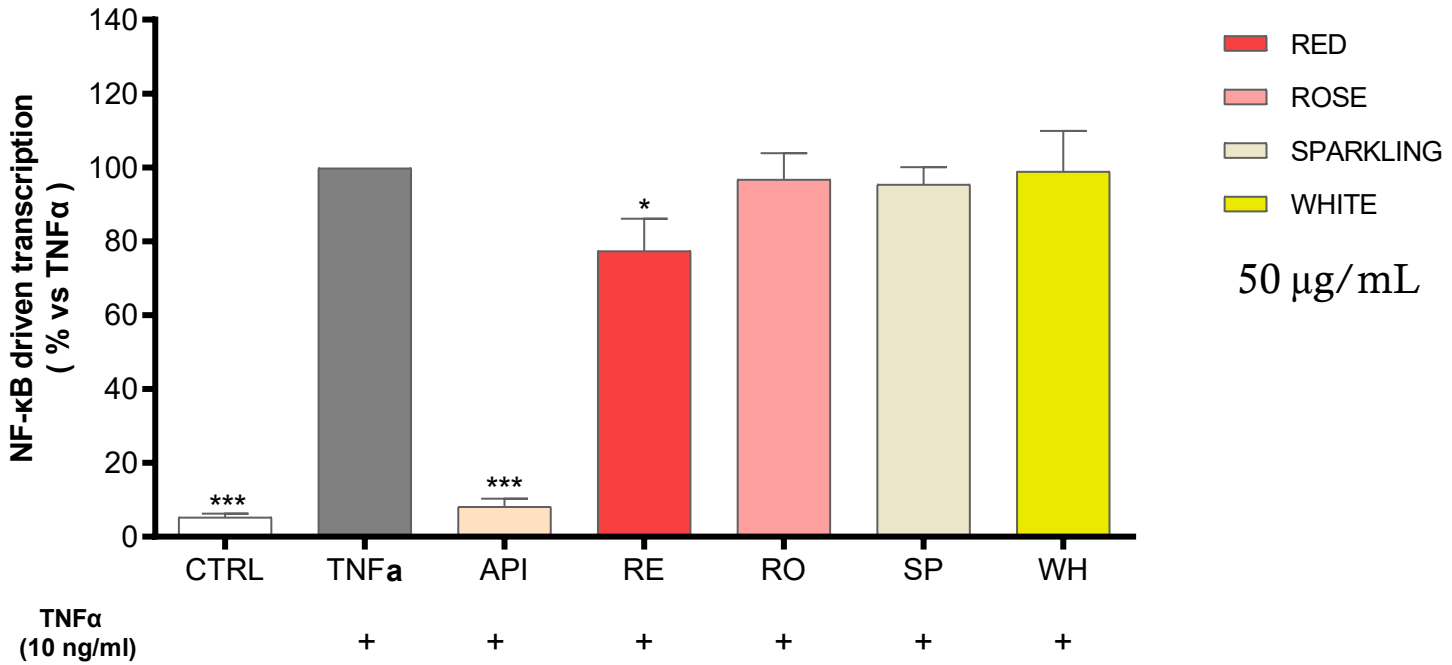
RESULTS

CHEMICAL ANALYSIS

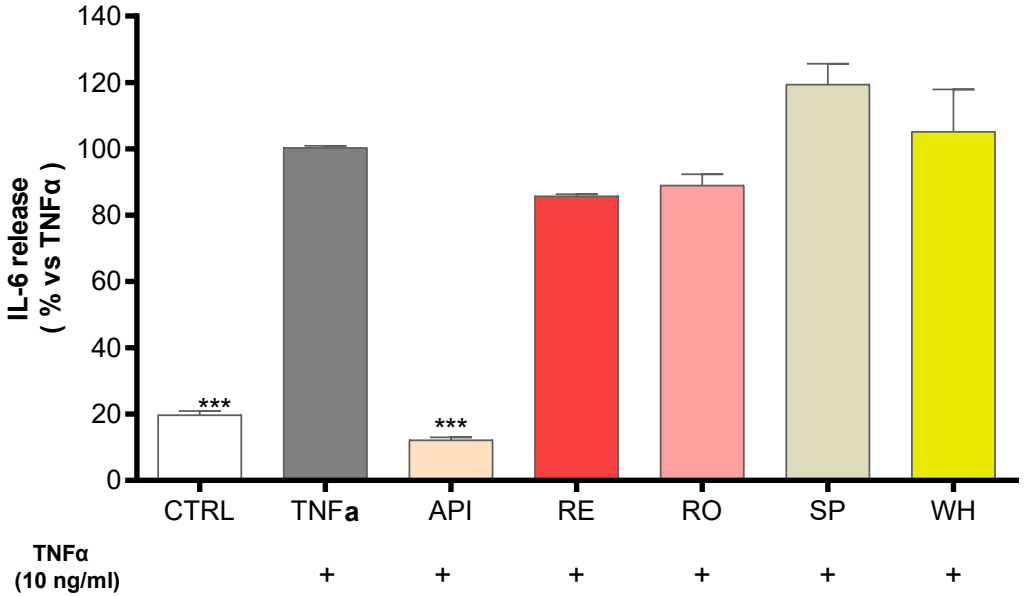
Sample	Total Acidity (g/L)	pH	Sugar (° Brix %)	Total polyphenols (mg GAE/L)	Total Flavonoids (mg catechin/L)	Total Anthocyanins (mg C3glc/L*)	ORAC (µM Trolox eq./g)	DPPH (µM Trolox eq./g)
RE	6.56 ± 0.01	3.31 ± 0.0	7.2 ± 0.06	2737.53 ± 34.52	4643.18 ± 1.54	187.64 ± 0.55	1018.78 ± 15.27	125.18 ± 0.62
RO	5.87 ± 0.01	3.00 ± 0.00	5.67 ± 0.03	431.37 ± 9.18	950.56 ± 2.57	8.73 ± 0.02	328.53 ± 22.78	15.30 ± 1.17
SP	6.72 ± 0.01	2.98 ± 0.00	5.23 ± 0.03	318.77 ± 5.80	667.99 ± 0.79		196.69 ± 9.44	2.55 ± 0.31
WH	6.65 ± 0.01	2.97 ± 0.00	5.53 ± 0.03	361.19 ± 5.50	784.12 ± 0.68		302.36 ± 13.11	3.67 ± 0.23

*C3glc=Cyanidin-3-glucoside

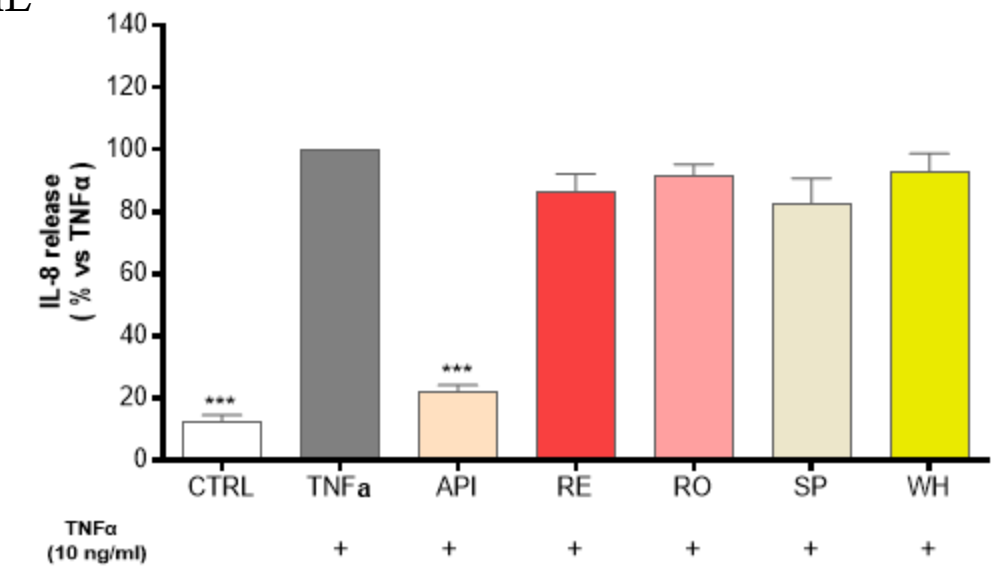
BIOLOGICAL ASSAYS



BIOLOGICAL ASSAYS



50 µg/mL

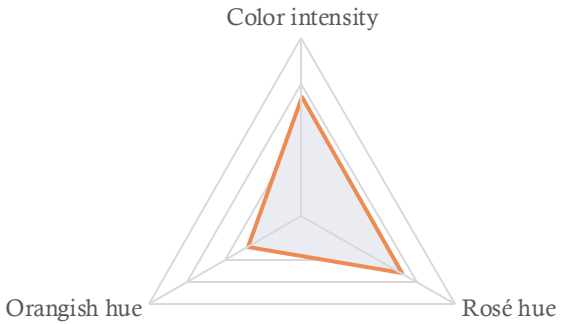


50 µg/mL

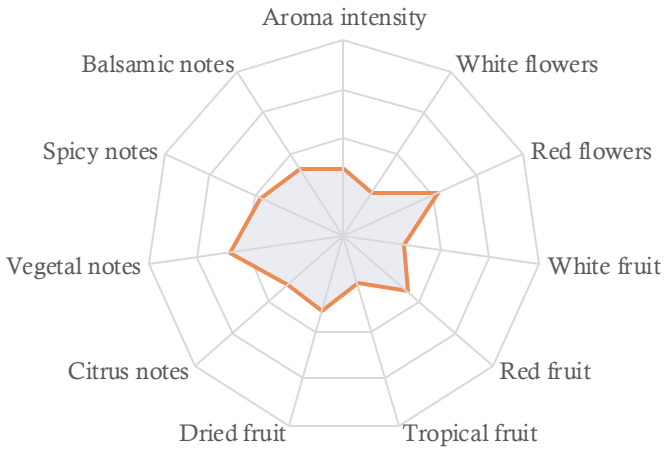
PANEL TEST

Rosè

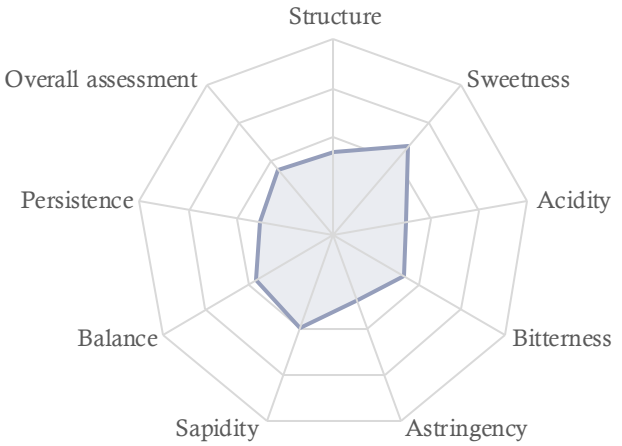
Visual analysis



Olfactory analysis

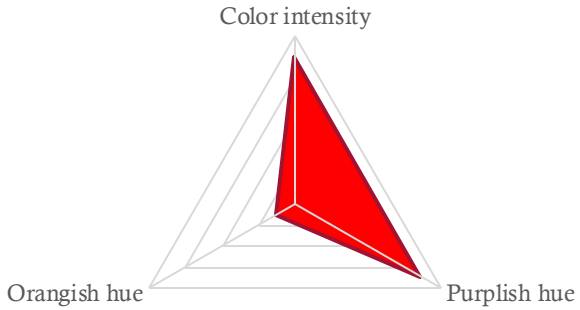


Gustative analysis

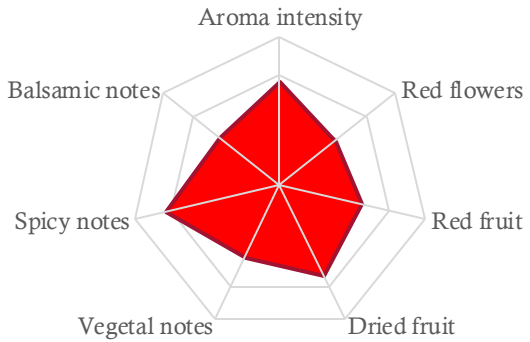


Red

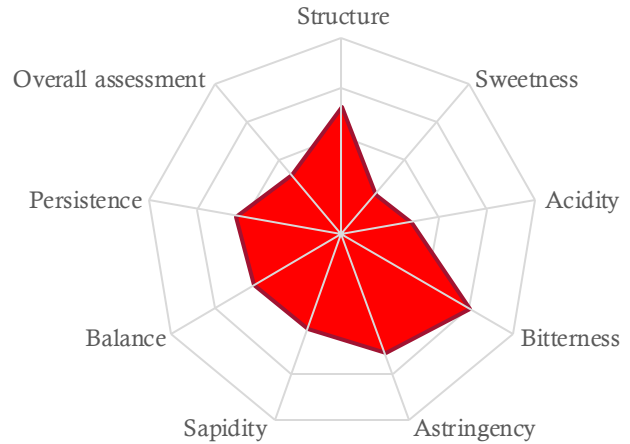
Visual analysis



Olfactory analysis



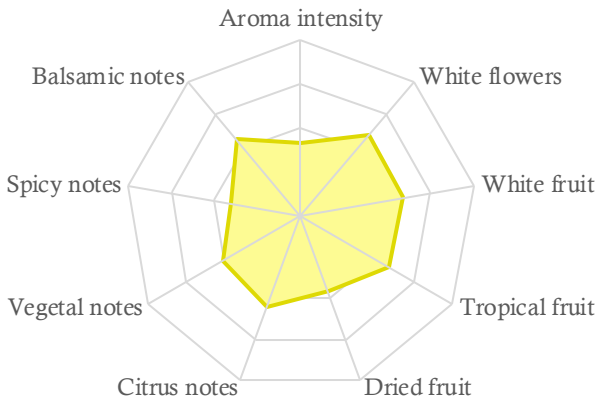
Gustative analysis



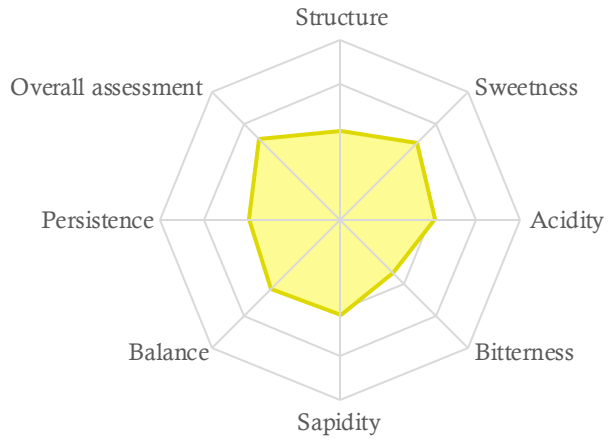
White

Visual analysis

Olfactory analysis

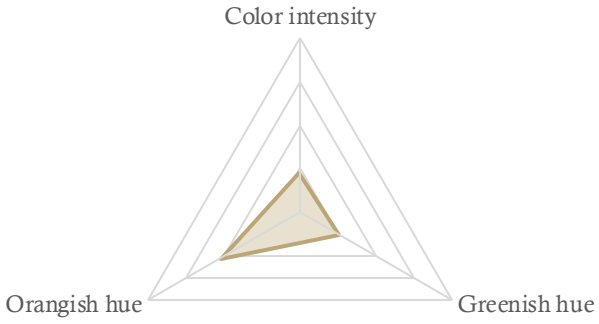


Gustative analysis

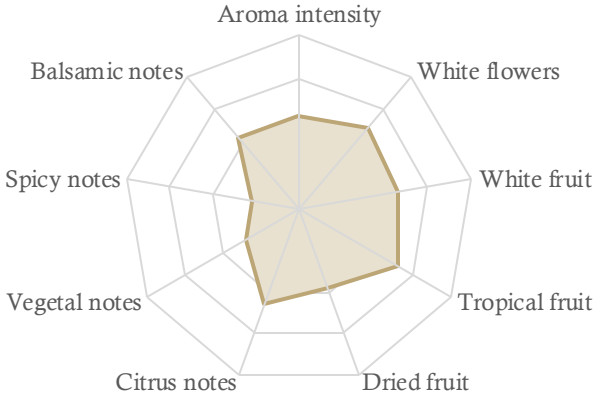


Sparkling

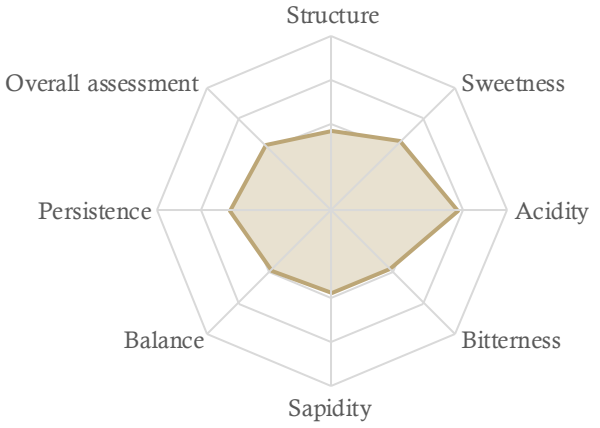
Visual analysis



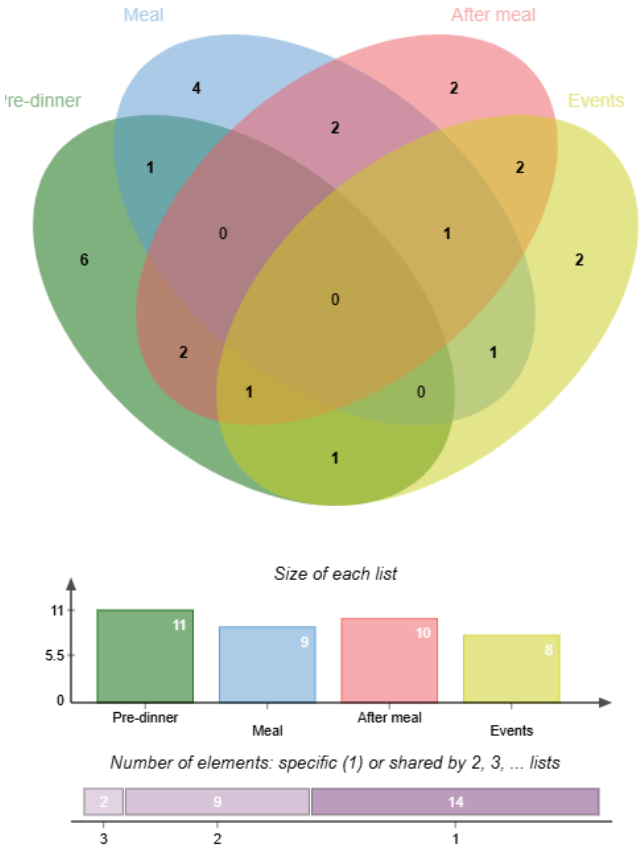
Olfactory analysis



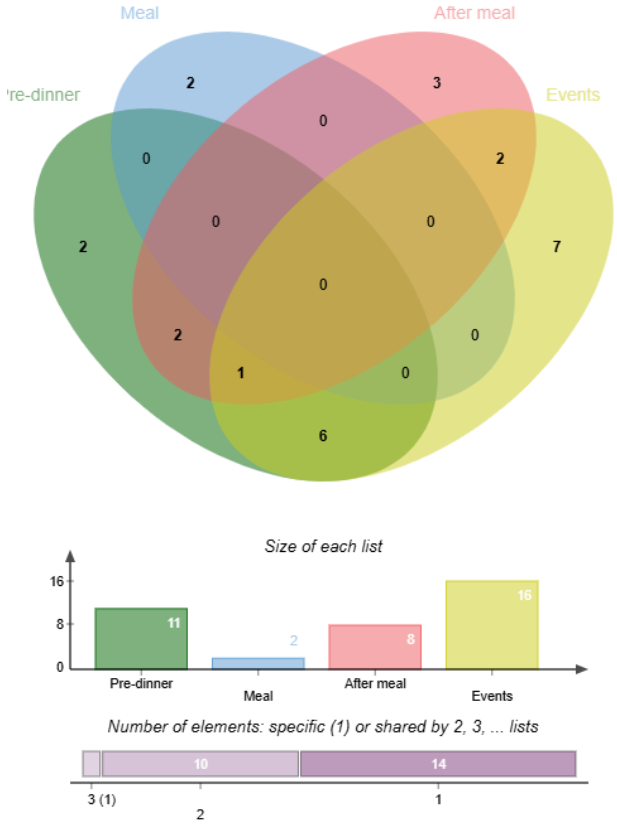
Gustative analysis



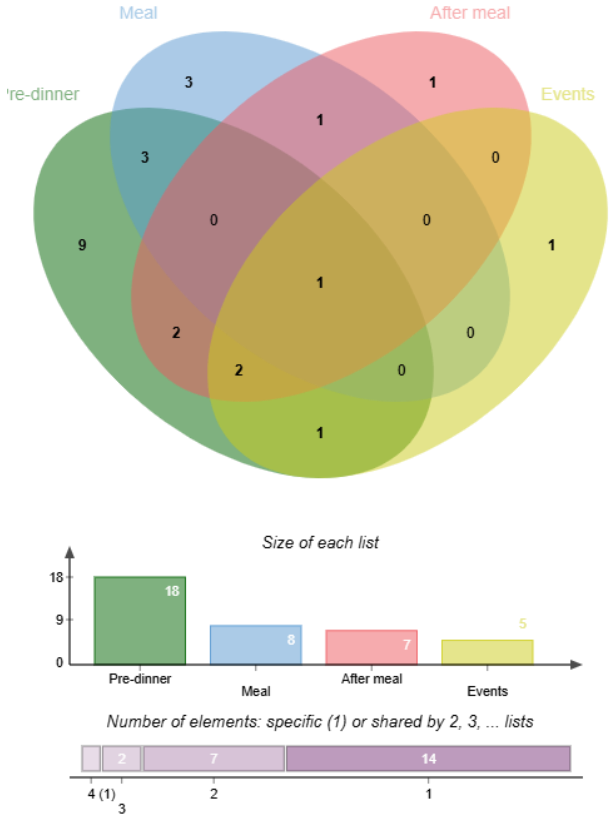
Distribution of Intended Consumption Occasions



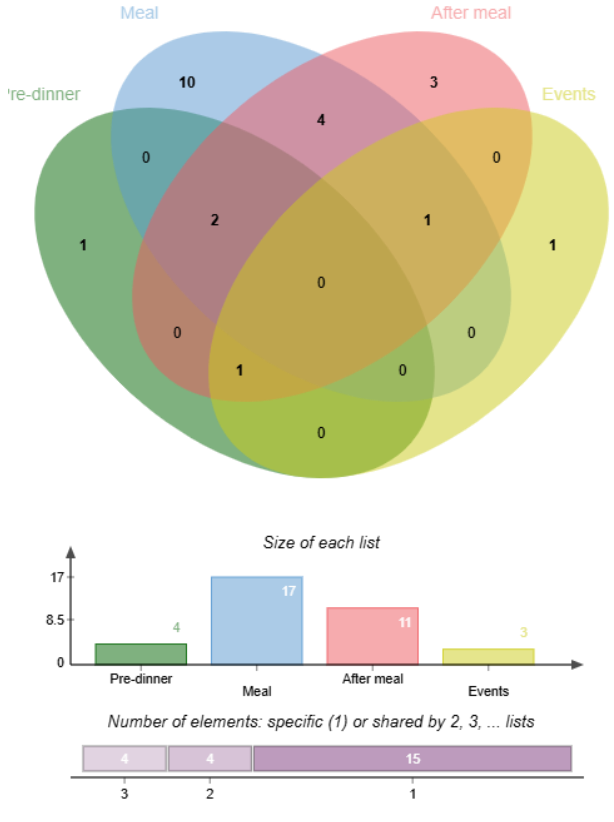
White



Sparkling



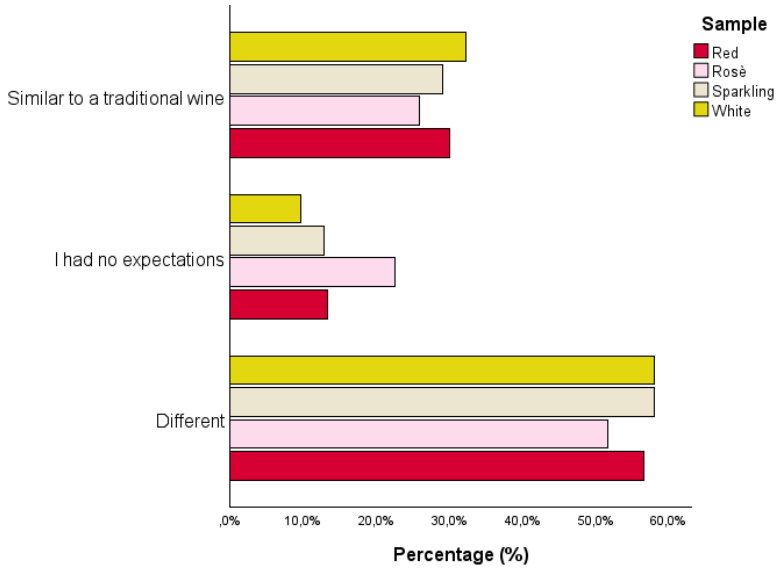
Rose



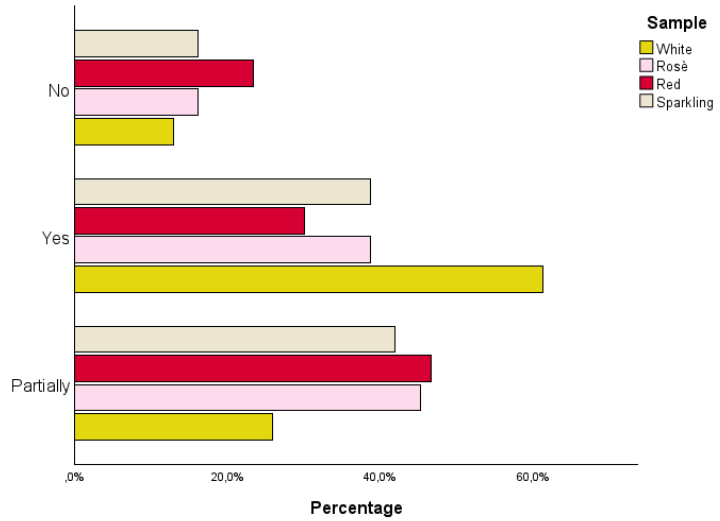
Red

Perceived Expectations and Tasting Experience

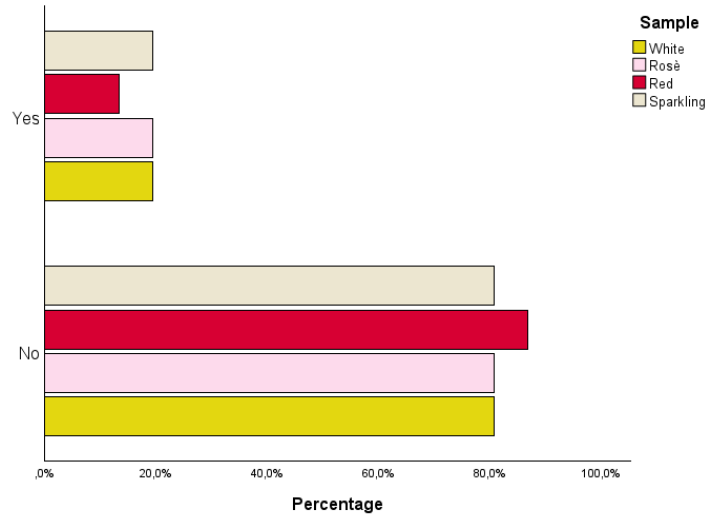
Before tasting, you expected the dealcoholized wine to be:



After tasting, do you think the wine met your expectations?

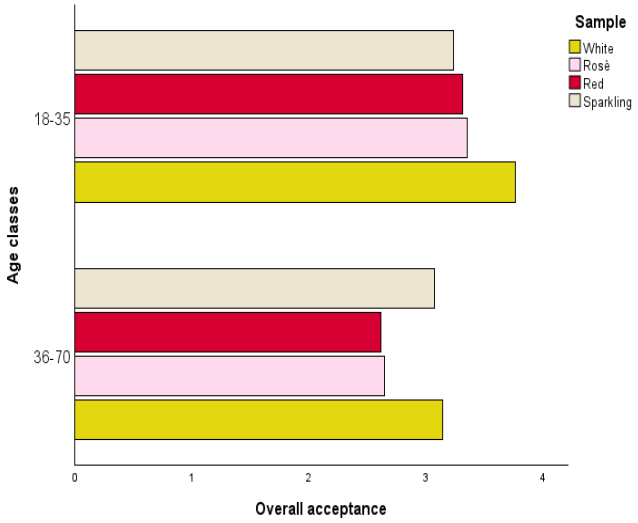


Have you ever drunk dealcoholized wine before?

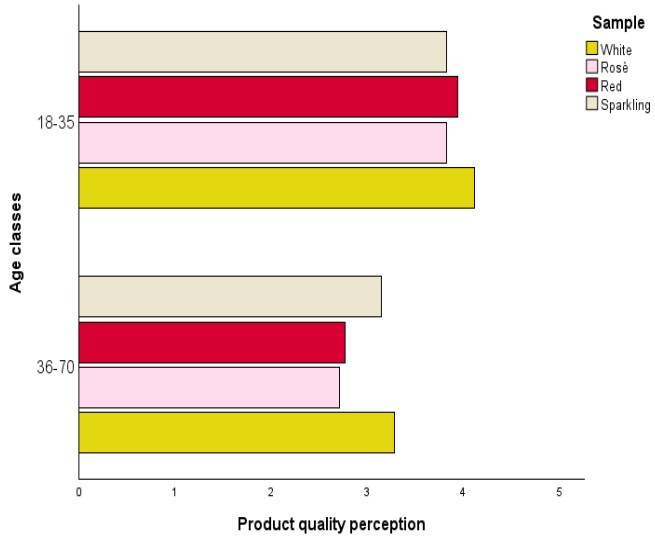


Perceived Quality and Pleasantness

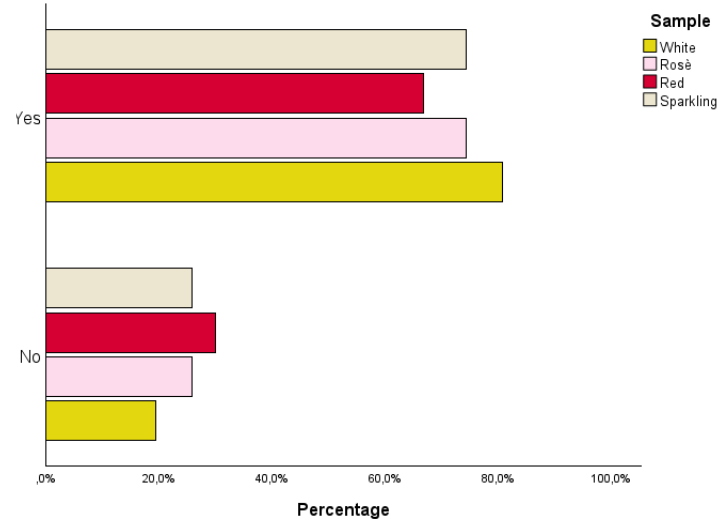
Overall acceptance



Do you perceive it as a quality product?



Would you consider it a valid choice for yourself or your friends?



PRELIMINARY FINDINGS ON THE AROMATIC PROFILE

Wine Type	Chemical Class	Compound	Aroma Descriptor
Red	Alcohol	2-Phenylethanol	Rose-like, honey, lilac
	Alcohol	2-(Indol-3-yl)ethanol	Mildly floral, fermented
	Acid ester	Butanedioic acid, diethyl ester	Mildly fruity, wine-like
	Aromatic aldehyde	Benzaldehyde	Almond, marzipan
	Aromatic aldehyde	Benzaldehyde, 4-hydroxy-2-methoxy-	Vanilla-like
	Phenols	Vanillin	Sweet, vanilla, almond-like
	Terpenes	β-Ionone	Violet, berries
	Aromatic ketone	Benzophenone derivative	Subtle phenolic, sweet resin
	Lactones	2(3H)-Furanone	Coconut, caramel
	Fatty acid ester	Hexanoic acid, ethyl ester	Fruity, green apple peel
	Fatty acid	n-Hexadecanoic acid	Waxy, neutral
Rosé	Alcohol	2-Phenylethanol	Rose-like, honey, lilac
	Aromatic aldehyde	Benzaldehyde	Almond, marzipan
	Fatty acid ester	Butanedioic acid diethyl ester	Apple
	Fatty acid ester	Hexanoic acid, (E)-2-hexenyl ester	Green-fruity, fatty
	Furanone derivative	2(3H)-Furanone derivatives	Toasty, caramel-like
	Lactone	5-Hydroxydecanoic acid lactone	Creamy, peach, coconut
White	Alcohol	2-Phenylethanol	Rose-like, honey, lilac
	Aromatic aldehyde	Benzaldehyde	Almond, marzipan
	Aldehydes	Myristaldehyde	Citrus peel
	Fatty acid ester	Decanoic acid, decyl ester	Fatty, creamy, waxy
	Monoterpenoids	hotrienol	Hyacinth
	Monoterpenoids	Cis-linalool oxide	Citrus
	Terpenes	Azulene	Herbal
	Naphthalenes	TDN	Kerosene, camphor
Sparkling	Alcohol	2-Phenylethanol	Rose-like, honey, lilac
	Alcohol	4-Hydroxyphenylethanol	Mildly floral/phenolic
	Aromatic aldehyde	Benzaldehyde	Almond, marzipan
	Terpene	Linalool oxides, derivatives	Floral, citrus, lychee
	Aldehydes	Tetradecanal	Citrus
	Polycyclic aromatic hydrocarbon	Naphtalene, 1,2,3,4-tetrahydro-6-1-phenylethyl	Vanilla, cinnamon, woody
	Benzoic acid ester	p-Anisic acid, 4-nitrophenyl ester	Anis
	Fatty acid	Octanoic acid	Fatty, waxy
	Acid ester	Diethyl succinate (likely)	Mild fruity, wine-like
	Esters	p-Hydroxycinnamic acid, ethyl ester	Honey, balsamic
	Phenolic compound	4-Hydroxy-3-methoxystyrene	Spicy, clove-like
	Furan derivative	2(3H)-Furanone-5-acetic acid derivative	Sweet, caramel

GC analysis was performed using a Thermo Fisher Trace 1300, both in headspace (HS) mode and with direct liquid injection. A BP-21 capillary column (60 m × 0.25 mm i.d.; 0.25 µm film thickness) was used.

CONCLUSIONS

This study provides preliminary insights into the chemical profiles and biological effects of four commercial dealcoholized wines available in Italy, as well as consumer preferences

01

Dealcoholized wines showed **higher acidity and lower sugar levels respect to traditional wines**, consistent with early grape harvesting; **total polyphenol content** was generally **preserved**.

02

The absence of alcohol in red wine seems to be effective **in reducing inflammation mediated by NF-kB**; however, pro-inflammatory cytokine release seems not to be influenced.

03

The panel test provided interesting data on the potential acceptance of dealcoholized wines, **especially among younger participants**, with white wine being the most appreciated.

FUTURE DIRECTION

Inclusion of a larger number of samples from different European markets
Comparative chemical analysis with corresponding alcoholic wines made from the same grapes
Quantification of individual phenolics and volatile compounds by HPLC and GC-MS
A more representative consumer panel

Special thanks to: Patrizia Restani and Carola Pozzoli

THANK YOU FOR THE ATTENTION

GRAZIE DELL'ATTENZIONE

MULȚUMESC PENTRU ATENȚIE

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