



MODERATE INTAKE OF BEER IMPROVES NONALCOHOLIC FATTY LIVER DISEASE (NAFLD) IN HIGH FAT DIET (HFD)-INDUCED MOUSE MODEL

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Beer, containing hundreds of different compounds, is one of the oldest, most consumed and popular drinks in the world. Some compounds are directly derived from raw materials and others are produced during brewing. Raw material sources of chemicals in beer are water, malt (along with adjuncts such as wheat, rice, corn or sugar), hops and yeast.

Beers are primarily classified according to the fermentation process.

Ale-type beers are produced by high fermentation, occurring between 16 and 24 °C after which yeast cells rise to the surface of the fermentation media, forming a thick film that is not generally removed completely.

In recent years, the nutritional interest of beer has increased because it is rich in antioxidant compounds with low ethanol content.



Belgian Ale
Birrificio Centolitri (Baschi,
Terni)



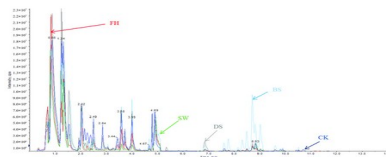


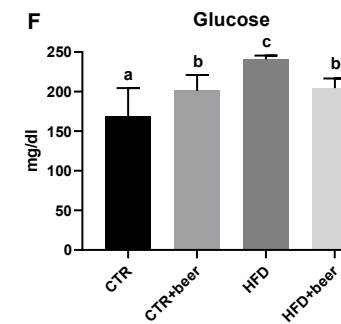
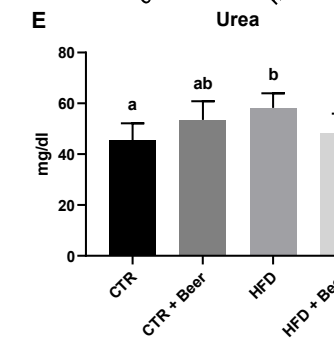
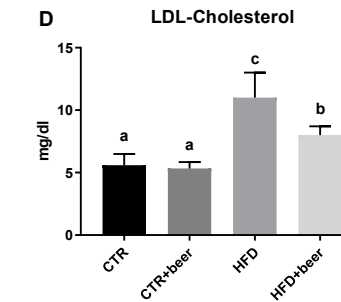
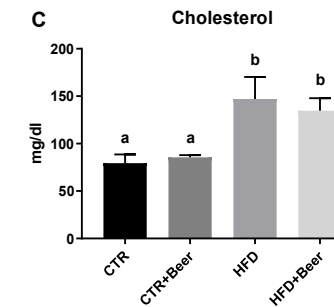
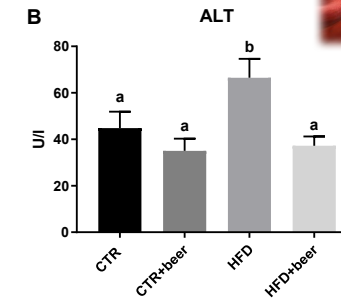
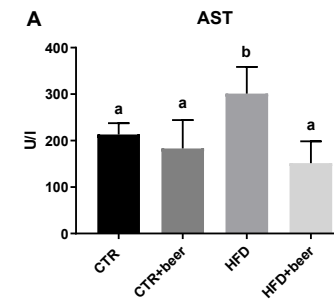
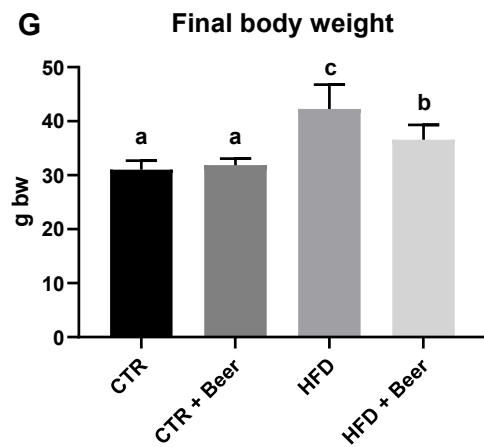
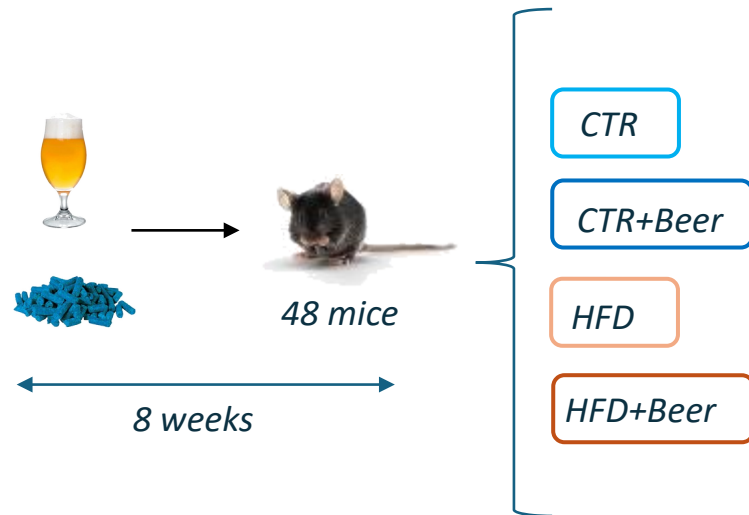
Table 1. Bioactive compounds and *in vitro* antioxidant activity of beer.

		Beer
Bioactive compounds	Total polyphenols (mg GAE/100 ml)	25.01 ± 1.27
	Flavonoids (mg CE/100 ml)	3.17 ± 0.17
	Flavonols (mg QE/100 ml)	3.07 ± 0.23
Antioxidant activity	ORAC (mg TE/100 ml)	103.10 ± 7.01
	FRAP (mg TE/100 ml)	39.11 ± 0.42
	DPPH (mg TE/100 ml)	154.77 ± 13.05

Table 2. Content of individual phenolic compounds of beer (µg/100 ml).

Compound Name	µg/100 ml
Gallic Acid	62.70±2.00
3-O-Caffeoylquinic acid (Chlorogenic acid)	88.26±3.17
Protocatechuic acid	14.68±1.99
Caffeic Acid	11.91±1.40
Vanillic Acid	69.29±3.20
p-Coumaric Acid	2.38±0.20
trans-Ferulic Acid	29.87±2.28
Rosmarinic Acid	0.09±0.03
Σ Phenolic acids	279.17
Quercetin	0.54±0.24
Quercetin 3-O-glucoside	14684.60±2678.60
Quercetin 3,4-O-di-glucoside	10.56±1.35
Quercetin 3-O-rutinoside (Rutin)	169.43±30.25
Kaempferol 3-O-glucoside	99.59±10.30
Kaempferol 3-O-rutinoside	87.99±3.90
Σ Flavonols	15052.71
(+)-Catechin	415.29±37.40
(-)-Epicatechin	85.88±2.40
Apigenin	0.09±0.03
Σ Flavan-3-ols	501.27
Tyrosol	2245.90±56.00
Hydroxytyrosol	8.93±0.41
Naringenin	3.56±0.45
Erodictyol	0.73±0.25
Luteolin	0.51±0.20
Phloridzin	0.28±0.05
Resveratrol	0.19±0.09
Oleuropein	0.14±0.11
Verbascoside	0.08±0.05
Phloretin	0.02±0.00
Σ Others	2259.84





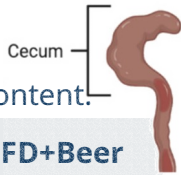
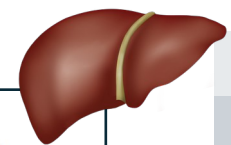
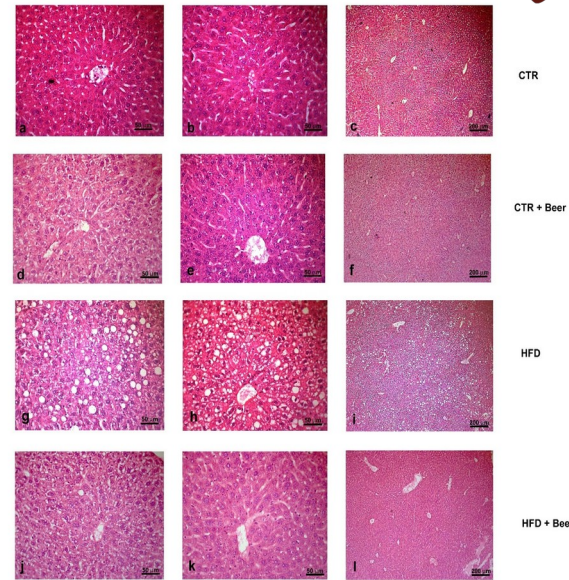
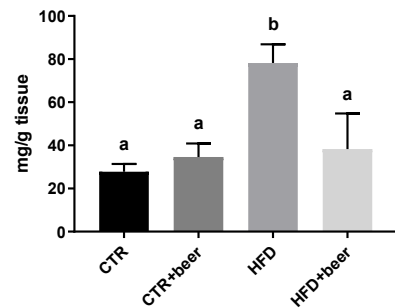


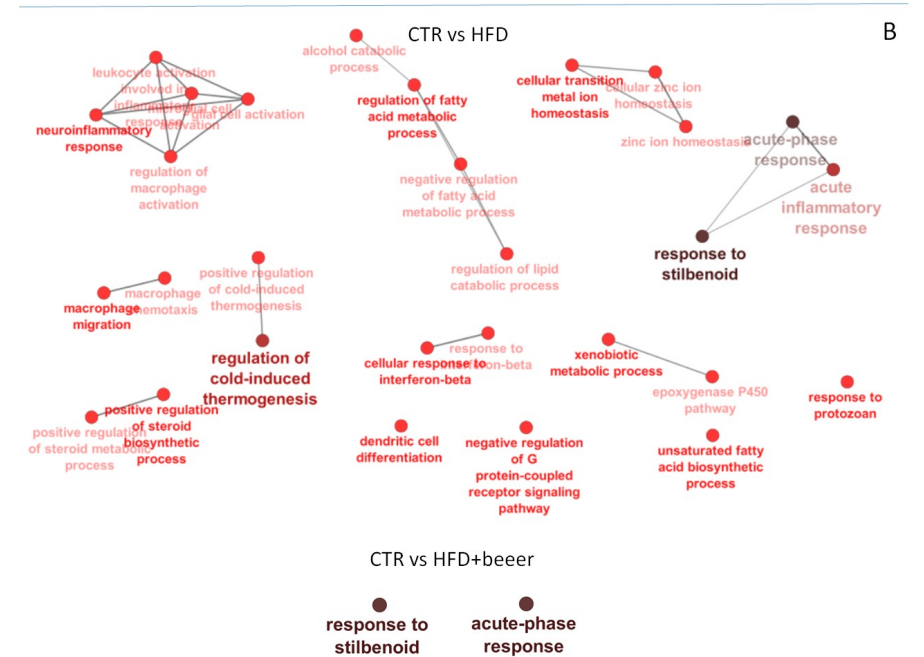
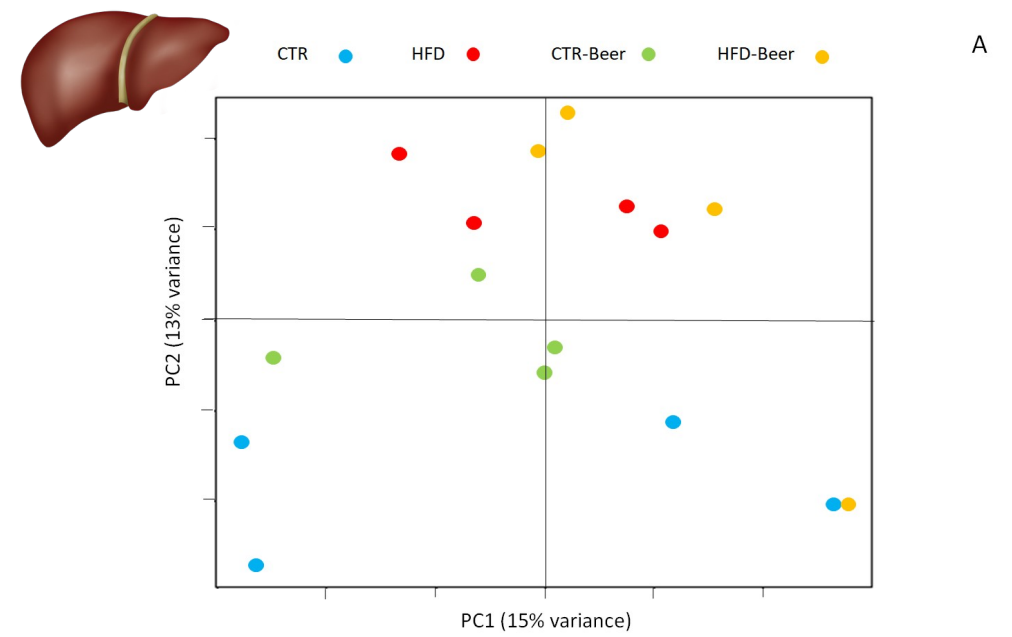
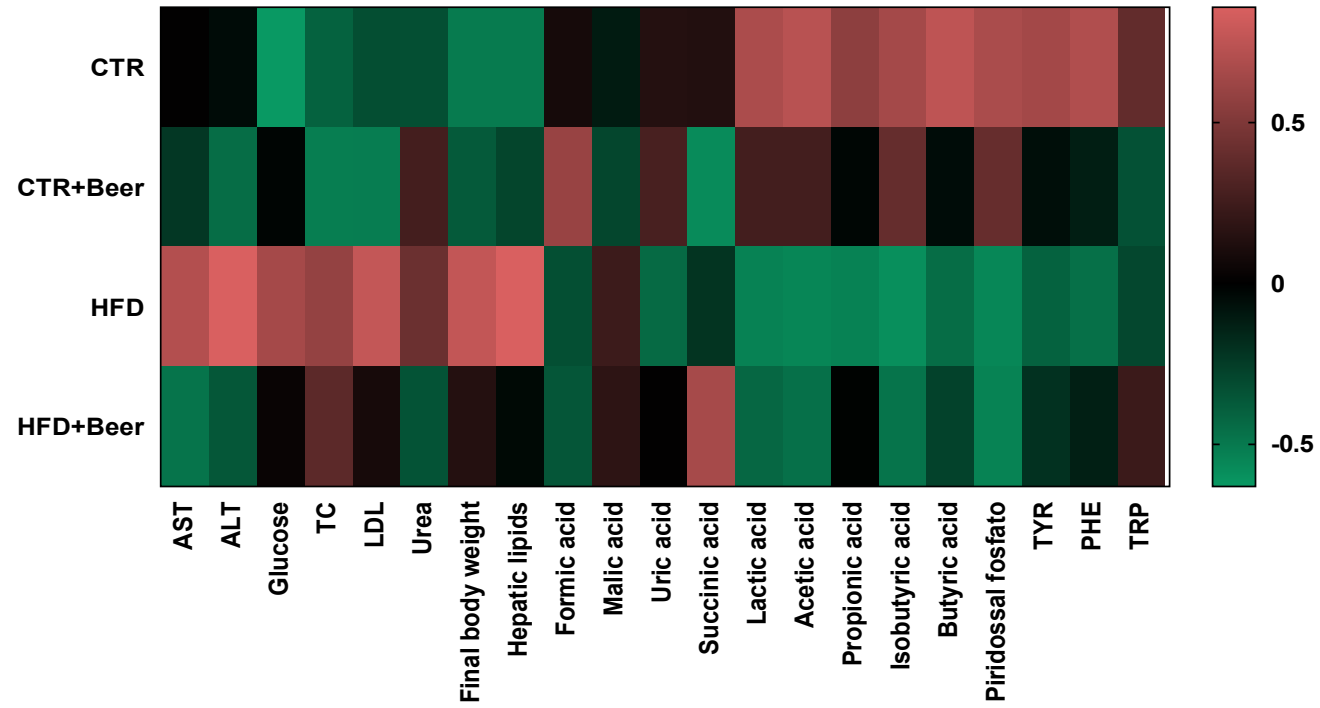
Table 3. Metabolites concentration ($\mu\text{mol/g}$) in cecal content.

Group	CTR	CTR+Beer	HFD	HFD+Beer
Formic acid	0.95 ^{AB} ±1.36	1.96 ^A ±0.99	0.17 ^B ±0.14	0.11 ^B ±0.09
Malic acid	0.82 ^A ±0.49	0.70 ^A ±0.42	1.05 ^A ±0.30	1.01 ^A ±0.24
Uric acid	0.01 ^A ±0.00	0.01 ^A ±0.00	0.00 ^A ±0.00	0.01 ^A ±0.01
Succinic acid	4.22 ^B ±1.20	2.59 ^C ±0.44	3.44 ^{BC} ±0.91	5.48 ^A ±0.69
Lactic acid	12.80 ^A ±4.83	9.32 ^A ±3.34	1.42 ^B ±0.34	2.52 ^B ±0.40
Acetic acid	20.59 ^A ±5.87	14.71 ^B ±3.80	2.68 ^C ±1.28	3.98 ^C ±0.64
Propionic acid	11.33 ^A ±4.27	7.68 ^{AB} ±3.56	4.21 ^B ±2.05	7.79 ^{AB} ±1.21
Isobutyric acid	0.72 ^A ±0.20	0.61 ^A ±0.15	0.03 ^B ±0.02	0.10 ^B ±0.03
Butyric acid	0.46 ^A ±0.24	0.21 ^B ±0.04	0.07 ^B ±0.02	0.13 ^B ±0.05
Piridossal fosfato	0.09 ^A ±0.02	0.08 ^A ±0.02	0.01 ^B ±0.00	0.01 ^B ±0.00
TYR	0.07 ^A ±0.02	0.04 ^B ±0.01	0.03 ^B ±0.01	0.04 ^B ±0.02
PHE	0.30 ^A ±0.07	0.19 ^B ±0.04	0.14 ^B ±0.05	0.18 ^B ±0.08
TRP	0.05 ^A ±0.02	0.03 ^A ±0.01	0.03 ^A ±0.01	0.04 ^A ±0.02



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Conclusions

All in all, our study demonstrated that moderate consumption of beer is able to prevent HFD-induced NAFLD in mice, likely due to its specific content in polyphenols able to restore the function of different genes involved in the regulation of lipid and sterol metabolism.

Thank you for you attention

