Preliminary Lipid-lowering Evaluation of Cold-pressed Camelina Sativa Oil

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Introduction and Objectives

- Camelina Sativa
  - An environmental friendly oil crop
  - Good agronomic characteristics
  - High level of unsaturated fatty acids

Table 1 Fatty acids compositions of Camelina Sativa oil

Compounds	Chinese variety	Reference[a]	Reference[b]
C16:0 (Palmitic acid)	5.0	6.4	5.3-5.6
C18:0 (Stearic acid)	2.4	2.6	2.3-2.7
C18:1 (Oleic acid)	15.0	17.4	14.0-16.9
C18:2 (Linoleic acid)	18.1	16.9	13.5-16.5
C18:3 (Linolenic acid)	34.5	35.2	34.9-39.7
C20:0 (Eicosoic acid)	1.3	—	—
C20:1 (Eicosenoic acid)	15.4	14.9	15.1-15.8
C20:2 (Eicosatrienoic acid)	1.8	—	—
C20:4(Arachidonic acid)	1.3	—	—
C22:1 (Erucic acid)	3.4	1.6	2.6-3.0
C24:0 (Tetracosanoic)	0.9	—	—

a: Abramovič and Abram, 2005
b: Zubr, 2003

- High ALA level oil possess blood lipid lowering activity: flaxseed oil, perilla oil, fish oil and etc
- Few reports about the biological activity of Camelina sativa oil
- Chinese camelina sativa oil with high ALA level
  - Obtained by urea adduction fractionation
  - Regulation of plasma lipid concentration and cholesterol metabolism in liver were studied.

Materials and methods

- Materials
  - Camelina sativa seeds provided by Beijing KangFuDuo biotechnology Ltd.
- Preparation of Camelina sativa oil with high ALA level by urea adduction fractionation
  - Saponificating→Cooling→Dissolving→Acidification→Extracting→Dehydrating
  - Fat acid composition of final product was 0.6% palmitic, 0.2% stearic, 9.0% oleic, 26.10% linoleic, 56.1% linolenic, 4.5% arachidonic.

- Animal test
  - Animals: Shanghai Shanghai Sciple-Bi-kai experimental animals Ltd. (Prospective SCXK (Shanghai) 2003-0002)
  - Diets: High-fat diets were composed of 78.7% basic diets, 10% yolk power, 10% saturated fatty acids, 1% cholesterol and 0.3% bile salts.
  - Grouping :
    - Fed with basic diets (Control)
    - High-fat diets (HFD)
    - High-fat diets and 1.1g fish oil/kg.bw (HFD+FO)
    - High-fat diets and 1.1g Camelina oil/kg.bw (HFD+LCO)
    - High-fat diets and 2.2g Camelina oil/kg.bw (HFD+MCO)
    - High-fat diets and 4.4g Camelina oil/kg.bw (HFD+HCO)

- Determination:
  - Body weights and liver weights
  - TC content in blood plasma : CHOD-PAP method
  - TG content in blood plasma : GPO-PAP method
  - ALT and AST activity in serum: kits
  - HDL content in plasma: PEG 20000-cholesterol oxidase method
  - Lipoprotein in plasma : Agarose gel electrophoresis.
- Statistics:
  - Expressed as means±standard deviation of three replications
  - Student’s test.

Results

- Body weight and ratio of liver to body weight

Table 2 Liver weight and liver / body weight of rats

Group	Body weight(g)	Liver weight(g)	Liver /body weight(%)
Control	425.4±39.9	11.88±1.44##	2.79±0.15##
HFD	484.3±37.2	21.42±2.67**	4.50±0.44**
HFD+FO	439.8±38.6	17.08±3.48**##	3.88±0.51**##
HFD+LCO	459.6±48.0	19.44±3.14**	4.21±0.32**
HFD+MCO	442.6±28.8	18.44±1.89**##	4.16±0.26**##
HFD+HCO	438.4±50.7	17.59±3.63**##	3.98±0.41**##

Note：.** P<0.01, compared with Control; ## P<0.01, compared with HFD.

Body weight, liver weight and liver/body weight of rats fed with medium dose and high dose ALA were lower significantly than high-fat control rats (P<0.01), but higher significantly than basic control rats (P<0.01).

- TC and TG content in plasma of rats (mmol/L)

Table 3 TC content in plasma of rats (mmol/L)

Group	End of the second week	End of the fourth week	End of the sixth week
Control	2.69±0.29##	2.73±0.30##	2.68±0.27##
HFD	3.53±0.28**	4.78±0.38**	6.34±0.41**
HFD+FO	2.81±0.20##	3.15±0.19**##	3.42±0.28**##
HFD+LCO	2.94±0.32##	3.85±0.30**##	5.11±0.29**##
HFD+MCO	2.91±0.34##	3.55±0.19**##	4.40±0.24**##
HFD+HCO	2.83±0.18##	3.03±0.35##	3.57±0.27**##

Note：* P<0.05 ** P<0.01,compared with Control； # P<0.05， ## P<0.01, compared with HFD; the same as tab 4 tab 5 and tab 6.

Table 4 TG content in plasma of rats (mmol/L)

Group	End of the second week	End of the fourth week	End of the sixth week
Control	0.84±0.11	0.87±0.17##	0.89±0.26##
HFD	1.09±0.39	1.31±0.20**	1.32±0.22**
HFD+FO	0.85±0.15	0.99±0.10##	0.98±0.15##
HFD+LCO	0.90±0.20	1.06±0.11**##	1.11±0.14*#
HFD+MCO	0.91±0.13	0.97±0.10##	1.02±0.22##
HFD+HCO	0.82±0.12	0.93±0.09##	0.96±0.20##

At the end of fourth week and sixth week, TG and TC content in rats fed with ALA were lower than high-fat control rats($P<0.05$), but TC content were still higher than basic control rats.

- TC and TG content in plasma of rats (mmol/L)

Table 5 HDL content in plasma of rats (mmol/L)

Group	End of the second week	End of the fourth week	End of the sixth week
Control	0.89±0.07	0.77±0.07##	0.69±0.08##
HFD	0.78±0.05**	0.57±0.08**	0.47±0.04**
HFD+FO	0.79±0.05**	0.45±0.08**#	0.37±0.05**##
HFD+LCO	0.81±0.04**	0.55±0.06**	0.42±0.03**#
HFD+MCO	0.78±0.06**	0.52±0.07**	0.40±0.04**#
HFD+HCO	0.78±0.07**	0.47±0.06**##	0.39±0.06**#

Table 6 HDL3/HDL ratio in plasma of rat

Group	End of the second week	End of the fourth week	End of the sixth week
Control	0.31±0.03#	0.33±0.07#	0.32±0.07#
HFD	0.24±0.07*	0.21±0.05*	0.22±0.05*
HFD+FO	0.30±0.06#	0.33±0.10#	0.34±0.07##
HFD+LCO	0.27±0.04	0.29±0.09	0.26±0.09
HFD+MCO	0.33±0.04##	0.36±0.10##	0.37±0.09*##
HFD+HCO	0.36±0.06##	0.40±0.11##	0.39±0.10**##

HDL content in plasma of rats fed with ALA were lower than high-fat control rats and basic control rats significantly (P<0.05). But HDL3/HDL value in rats fed with ALA were higher than high-fat control rats significantly (P<0.05).

- **TC TG content in liver and ALT AST content in plasma of rat**

Table 7 TC TG content in liver and ALT AST content in plasma of rat (mmol/g)

Group	Liver		Plasma	
	TG	TC	ALT	AST
Control	0.41±0.11##	0.21±0.05##	59.51±15.37	204.32±36.70##
HFD	1.62±0.20**	0.83±0.17**	91.19±35.46	297.29±60.67**
HFD+FO	1.02±0.39**##	0.53±0.23**##	67.95±16.55	235.3±27.42##
HFD+LCO	1.35±0.35**	0.65±0.20**	75.18±34.77	264.82±52.16**
HFD+MCO	1.17±0.15**##	0.58±0.16**#	59.35±21.98	223.71±43.73##
HFD+HCO	1.09±0.19**##	0.47±0.15*##	53.73±5.21	212.04±39.59##

TC and TG content in liver of rats fed with medium dose and high dose ALA were lower than high-fat control rats significantly (P<0.05), but still higher than basic control rats significantly (P<0.01). The similar change happened to ALT and AST content in plasma.

- Agarose gel elcetrophoresis analyisis

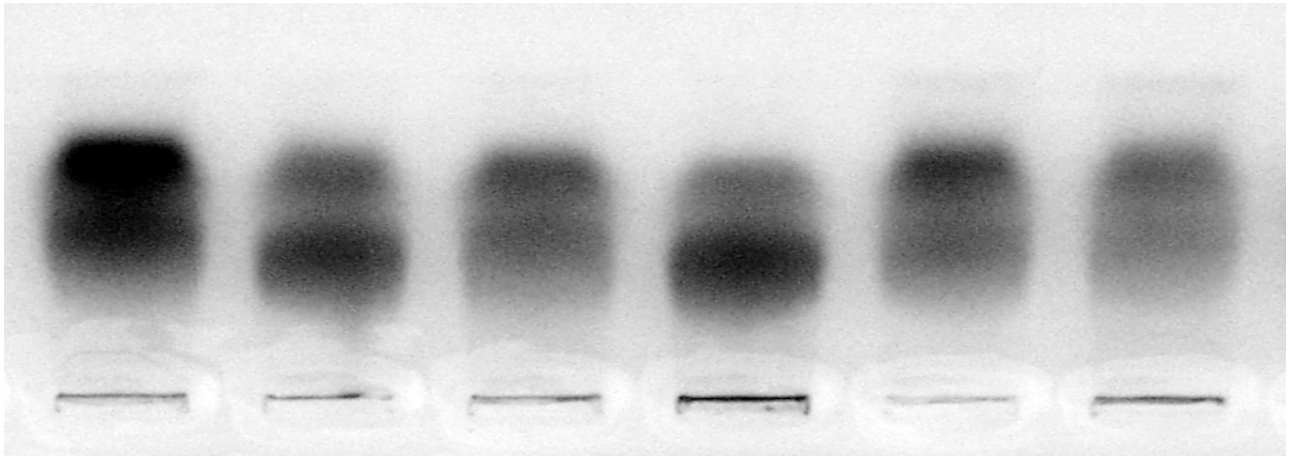

Figure 1 Agarose gel elcetrophoresis analyisis on lipoprotein in plasma of rats
Note: A, B, C, D, E, F represents Control group, HFD group, HFD+FO group, HFD+LCO group, HFD+MCO group and HFD+HCO group respectively.

Adjust the metabolism of HDL subset to make the HDL particles miniaturized.

Conclusions

- **ALA content: increased from 34.5% to 62.7% by urea adduction fractionation method firstly.**
- **HFD resulted typical hyperlipaemia**
- **Brought three changes compared with HFD group:**
  - **Growth performance got improved**
  - **The symptoms of dyslipoproteinemia got relieved**
  - **The impaired hepatic function got recovered partially**
  - **A tend of HDL particles' miniaturization**

Camelina Sativa oil containing high level of ALA possessed lipid-lowering activity by regulating the blood lipid metabolism and protecting liver function.