



Health benefits and prospects of sea buckthorn berry/seed oil

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Contents

- Taking type 2 diabetes as an example, prevalence and management of chronic diseases
- Active ingredients of sea buckthorn seed/berry oil
- Clinical trials on sea buckthorn seed/berry oil
- Preventive and therapeutic effects of sea buckthorn oil on chronic diseases and its potential clinical use





Peking University





Our team—A happy family !

“**Dounai group**”(豆奶一族 : dou means soybean,nai means milk)
means milk)



2 Professors, both Ph.D supervisor;

1 Associate Professor;

1 Assistant Professor

1 Lecturer,

6 Ph D Students,

2 Graduate Students for MS



News reported May 2024, Memorial University of Newfoundland, Canada

The continental news

Research Article

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Phenolic composition and bioactivities of sea buckthorn (*Hippophae rhamnoides* L.) fruit and seeds: an unconventional source of natural antioxidants in North America

Renan Danielski and Fereidoon Shahidi

Abstract

BACKGROUND: Sea buckthorn (*Hippophae rhamnoides* L.) was introduced into Canada in the early 2000s. This plant bears fruits with high commercial value in other countries due to its premium oil. Nevertheless, sea buckthorn berries are also a rich source of bioactives with nutraceutical potential, especially the variety grown in Newfoundland (Canada), which has not previously been characterized. As such, this study evaluated the composition of polyphenols in sea buckthorn pomace and seeds, as well as their prospective health-promoting effects.

RESULTS: Polyphenolic identification by high-performance liquid chromatography–ultraviolet–mass spectrometry–time of flight revealed the presence of 24 compounds in the seeds and 16 compounds in the pomace, including phenolic acids, flavonoids, and tannins, with ellagic acid derivative IV (pomace, 52.13 µg g⁻¹) and (+)-catechin (seeds, 690.8 µg g⁻¹) being the most dominant. Sea buckthorn extracts displayed *in vitro* antidiabetic and anti-obesity potential by inhibiting α-glucosidase (71.52–99.81%) and pancreatic lipase (14.89–33.61%) enzymes, respectively. The extracts also protected low-density lipoprotein cholesterol (50.87–89.63%) and supercoiled DNA (35.11–79.84%) from oxidative damage.

CONCLUSION: Sea buckthorn berries grown in Canada showed promising health benefits induced by their rich and diverse polyphenolic profile and need to be considered for further commercial expansion as a bioactive-loaded superfruit.
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Keywords: DNA damage; insoluble-bound phenolics; LDL-cholesterol oxidation; pomace and seeds; sea buckthorn (*Hippophae rhamnoides* L.)



J Sci Food Agric. 2024 Jul;104(9):5553-5564

Source of Natural Antioxidants, New Study Shows

Mar 21, 2024 by Amy Staff

» Previous | Next »

Published in

Food Science
Medicine
Nutrition

Tagged as

Antioxidant
Carotenoids
Fruit
Hippophae
Hippophae
rhamnoides
Newfoundland
North America
Plant
Polyphenol
Sea buckthorn
Seed

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New Study Shows More Light on Benefits of Coffee Consumption



Solid Wood Surfaces Have Natural Antibacterial Properties, Study Shows



Higher Fruit Consumption Reduces Risk of Depression, Study Suggests



Orange Peels

Berries of the sea buckthorn (*Hippophae rhamnoides*) grown in Canada showed promising health benefits induced by their rich and diverse polyphenolic profile and need to be considered for further commercial expansion as a bioactive-loaded superfruit.



The sea buckthorn (*Hippophae rhamnoides*). Image courtesy: Shutterstock / iStockphoto.com

Sea buckthorn is a deciduous, thorny plant found along the coasts of northwestern Europe as well as temperate regions of central Asia.



Non-communicated chronic disease

- T2DM

Lancet 2023; 402: 203–34

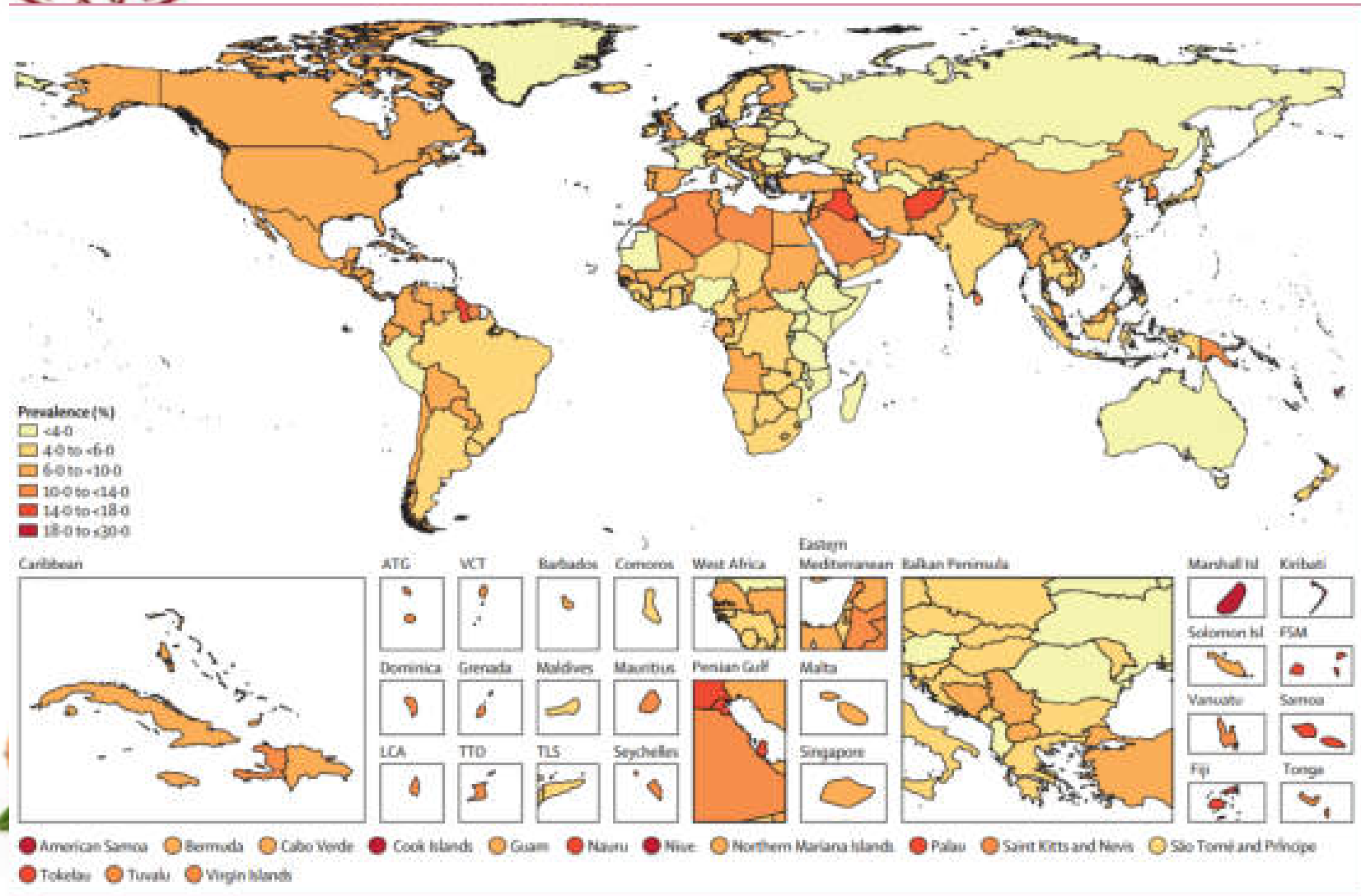


Figure 1: Age-standardized total diabetes prevalence rates in 2021

Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021

Prevalence increase by year in China

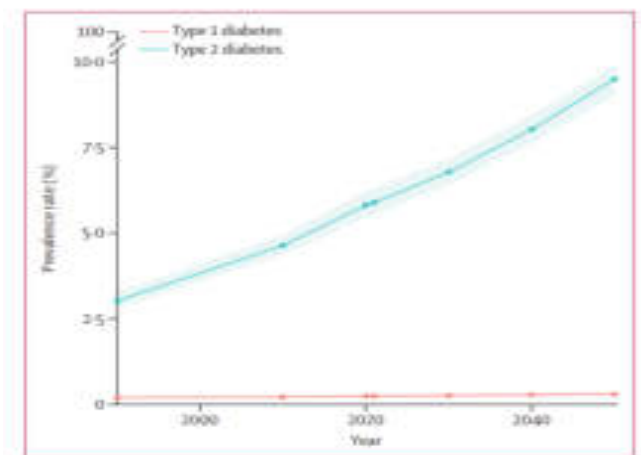


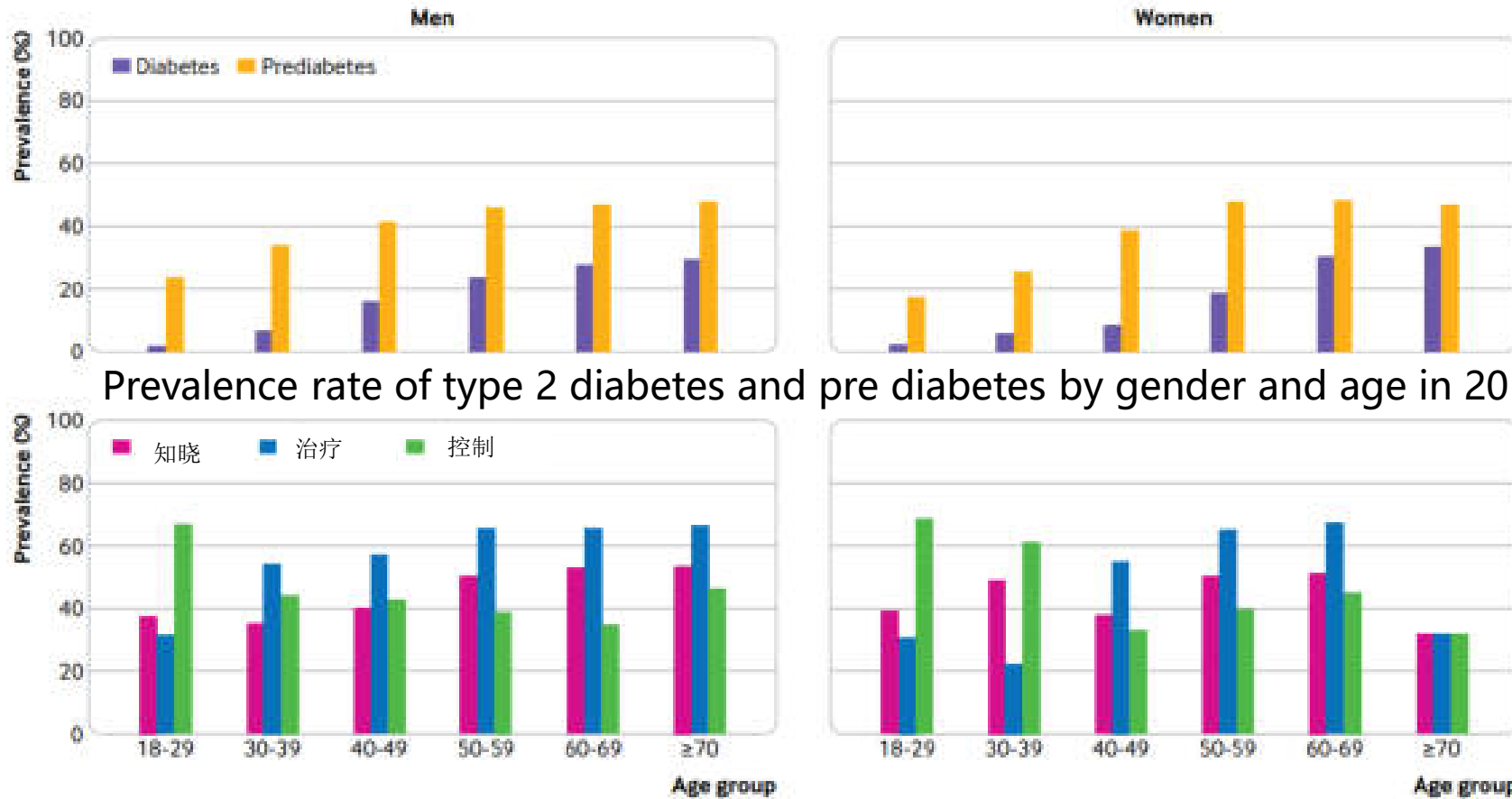
Figure 4: Global age-standardised prevalence of type 1 and type 2 diabetes from 1990 through 2050 forecasts. The shaded area represents 95% uncertainty intervals. Total diabetes is the sum of type 1 and type 2 diabetes.

Increasing burden(economy, life)



Non-communicated chronic disease

- T2DM



Prevalence rate of type 2 diabetes and pre diabetes by gender and age in 2017 (%)

Nearly half people at 40 to 69 years old are in pre diabetes

Not aware of
Not be treated
Difficult to control

Awareness rate, treatment rate and control rate of type 2 diabetes and early diabetes by gender and age in 2017 (%)





questions :

Same to
medicine?



Food with active
ingredients

Eat health, enjoy health

Where to
invest



F

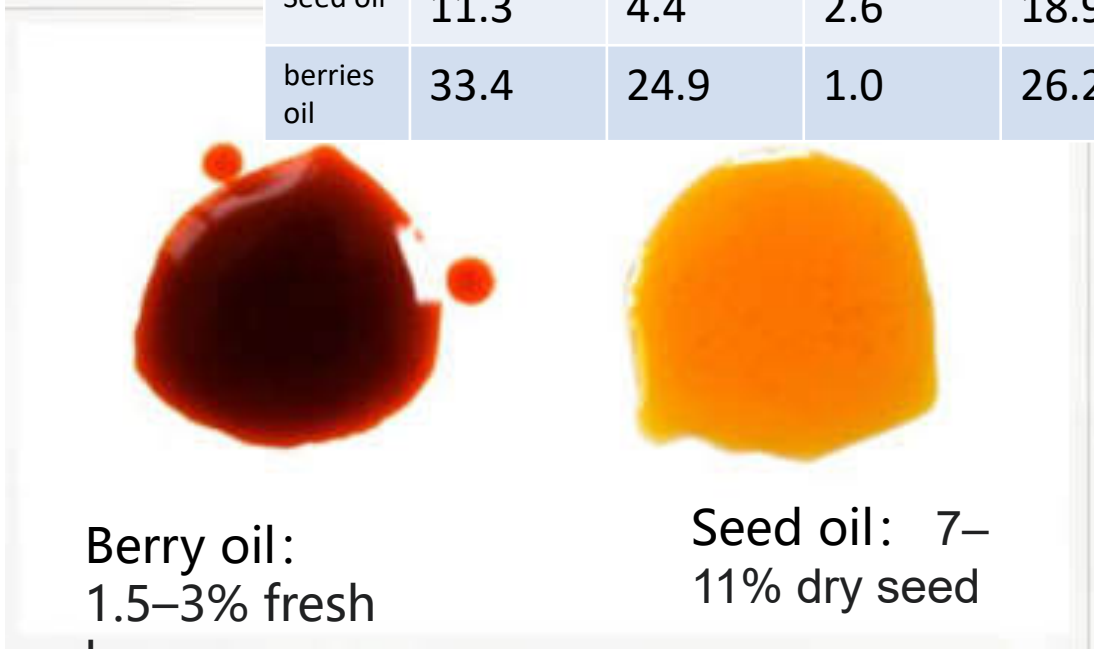
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Types of sea buckthorn oil

Types	Fatty acids							sitosterol (mg/g oil)	β - carotene(mg/100 g oil)
	Palmitic acid 16:0	Palmitoleic acid 16:1n-7	Stearic acid 18:0	Oleic acid 18:1n-9	Vaccenic acid 18:1n-7	Linoleic acid 18:2n-6	α -linolenic acid 18:3n-3		
Seed oil	11.3	4.4	2.6	18.9	3.2	34.1	24.9	5.6	48.9
berries oil	33.4	24.9	1.0	26.2	7.3	5.1	1.6	14	6.5



Berry oil:
1.5–3% fresh
berry

Seed oil: 7–
11% dry seed

Oil nutrients:

- ✓ Seed oil: rich in Linoleic acid (30–40% 18:2n-6) & α - linolenic acid(18:3n-3, 23–36%) ;
 - ✓ **Rich in n-3 & n-6 PUFA**
- ✓ Seed oil: Palmitoleic acid(16:1n-7, 24–39%).
 - ✓ **Rich in n-7 MUFA**

Common features: rich in n-9 PUFA

Yang B, Kallio HP. Fatty acid composition of lipids in sea buckthorn (*Hippophaë rhamnoides* L.) berries of different origins. *Journal of Agricultural and Food Chemistry*. 2001, **49** (4): 1939–1947





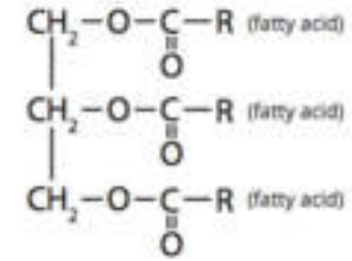
Fat (Triglyceride)

Approximately 10% -20% of normal body weight and 95% of lipids.



Mainly stored in adipose tissue, called stored fat. Others distributed under the skin, greater omentum, mesentery, and organs around.

The content in the body is unstable and increases or decreases due to the influence of nutritional status and body activity, known as "variable fat" and "dynamic fat".



Dietary fats consist mostly of triglycerides a compound of three fatty acids attached to a glycerol (carbon and hydrogen structure) backbone.

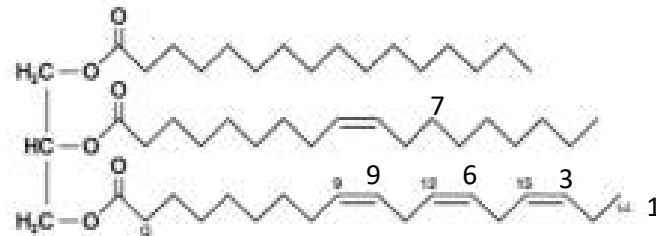
Animal fats: rich in saturated fatty acids

Plant oil: rich in unsaturated fatty acids or polyunsaturated fatty acids



Types of fatty acids & health

- Breastfeeding infants : Fat supply accounts for 45% -50% total energy ;
- Adults : 20-30% total E



- Saturated fatty acids(SFA): Palmitic acids(16:0) Coconut oil
- Mono-unsaturated acids(MUFA): **Oleic acids(18:1) n-9** Olive oil, camellia oil
- Poly-unsaturated acids(PUFA):** Linoleic acid(n-6), α -linolenic oil(n-3) **,DHA,EPA,DPA** Deep-sea fishes, salmon





Essential fatty acid

Definition: or EFAs, are fatty acids that are required by humans and other animals for normal physiological function that cannot be synthesized in the body. As they are not synthesized in the body, the essential fatty acids – alpha- linolenic acids (ALA) and linolic acids— must be obtained from food.

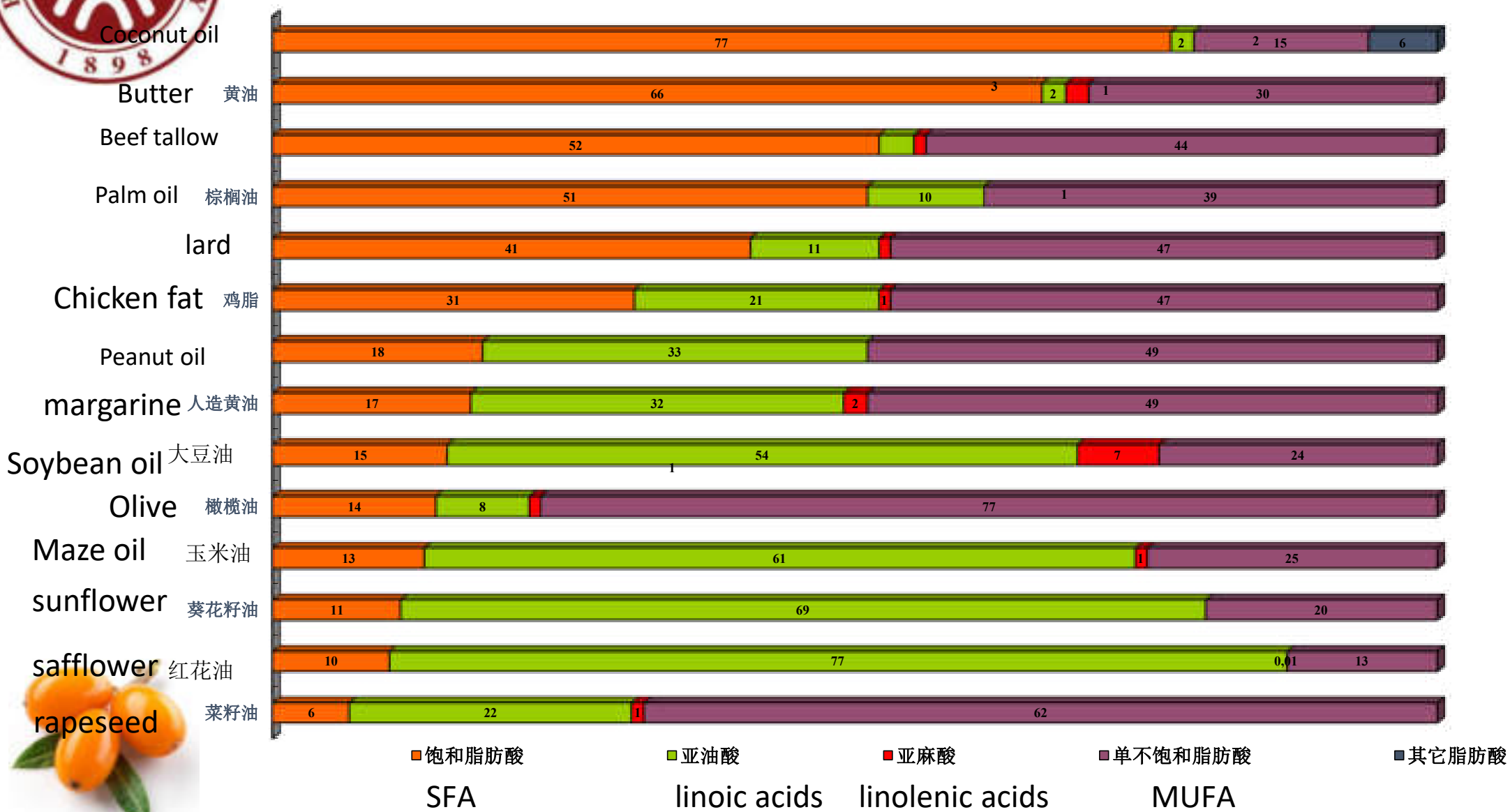
category : linolic acids (n-6) 、 alpha-linolenic acid (n-3, ω -3)

*Corn oil, cottonseed oil, grape seed oil,
peanut oil, safflower oil, sesame oil,
soybean oil, sunflower oil*





Fatty acid composition of dietary fat





Dietary Inflammatory Index

--To assess dietary food /nutrients/active ingredients

-Central-

● Insulin Resistance, IR
---pathological mechanism

-Turn on-

● Abdominal obesity
--Lipid accumulation

-Development-

● Inflammation
Lipid accumulation--inflammation—IR
low-grade systemic inflammation condition





Dietary factors affect metabolic syndrome through glucose and lipid metabolism pathways

Single food/nutrient

● Foods

Protective : vegetables, fruits, beans & products, fish, sea food
Risky: red meats, processed meat, refined grains

● Nutrients

Higher energy, fat,sugar, lower dietary fiber, vitamin D deficiency

Dietary quality assessment

● Dietary pattern

Mediterranean dietary pattern, Japanese dietary patterns

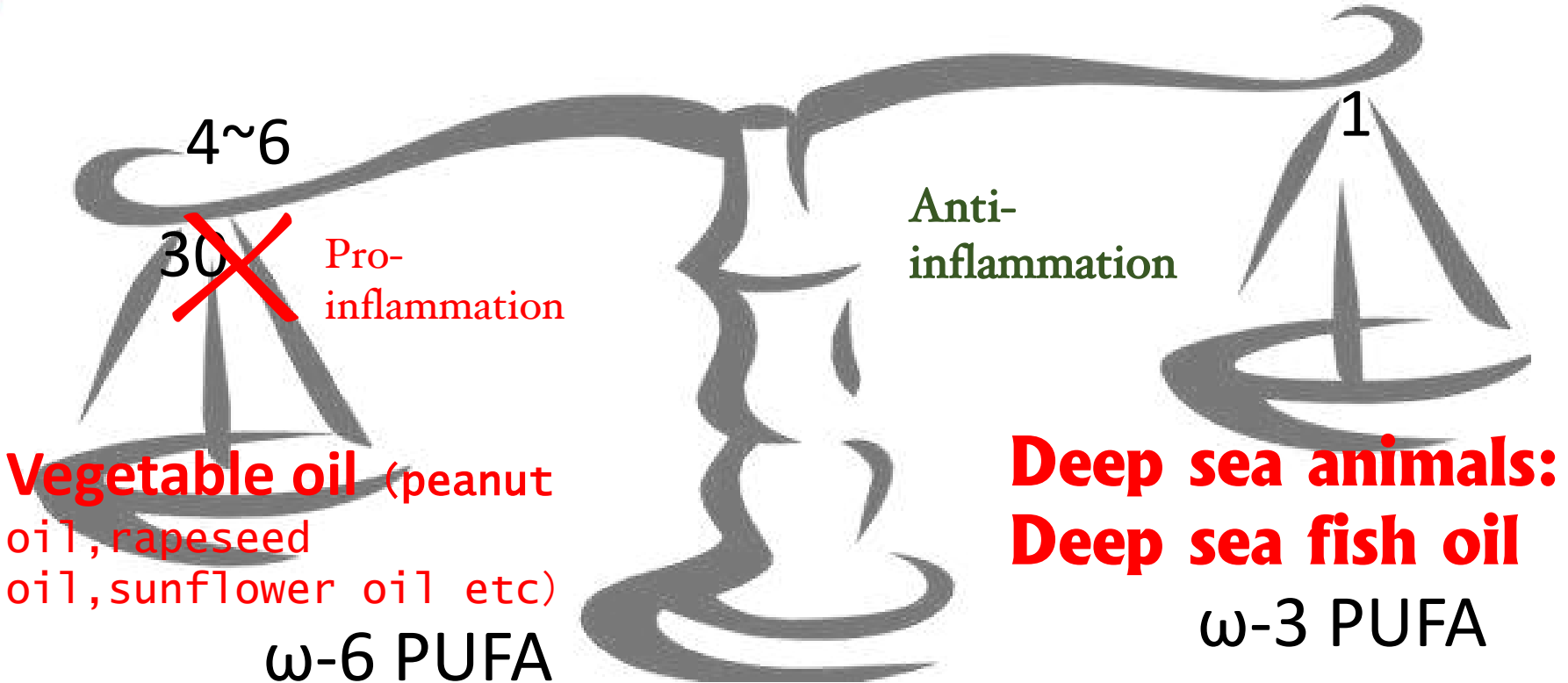
● Dietary quality score/index

Dietary diversity score, dietary balance index etc.





Ballanced fatty acids intakes



Unbalanced meal

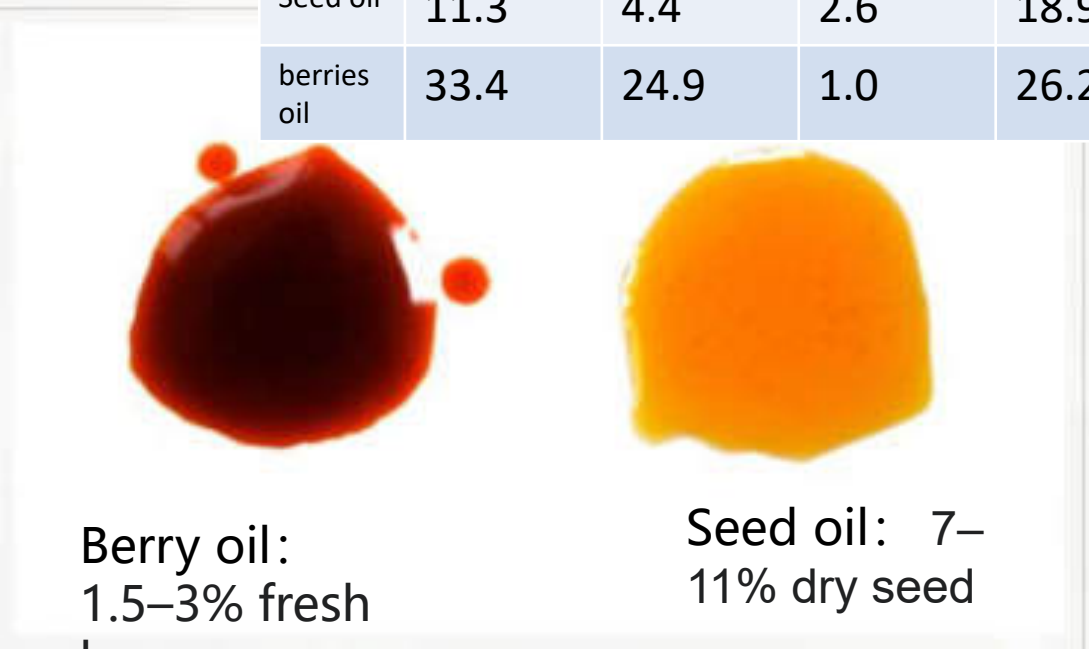


↑ Prevalence of inflammatory disease



Types of sea buckthorn oil

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Berry oil:
1.5–3% fresh
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Seed oil: 7–
11% dry seed



Yang B, Kallio HP. Fatty acid composition of lipids in sea buckthorn (*Hippophaë rhamnoides* L.) berries of different origins. *Journal of Agricultural and Food Chemistry*. 2001, **49** (4): 1939–1947

Oil nutrients:

- ✓ Seed oil: rich in Linoleic acid (30–40% 18:2n-6) & α - linolenic acid(18:3n-3, 23–36%) ;
- ✓ **Rich in n-3 & n-6 PUFA (1:1)**
- ✓ Seed oil: Palmitoleic acid(16:1n-7, 24–39%).

✓ **Rich in n-7 MUFA**
Common features: rich in n-9 PUFA



沙棘果的健康作用—— ω -7脂肪酸

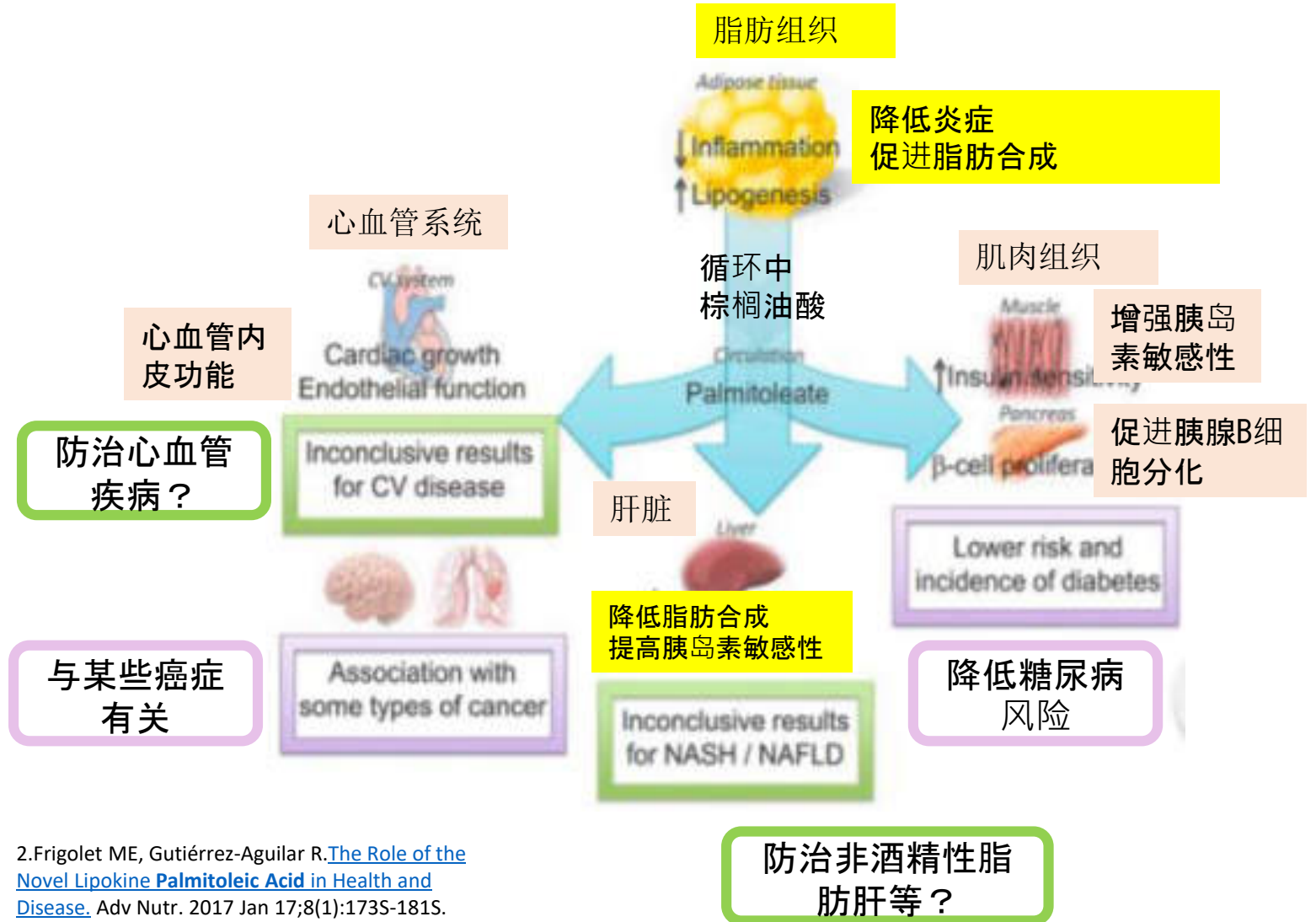
肥胖

心血管疾病

非酒精性脂肪肝

癌症（胆囊癌、脑瘤）

体外抗氧化等作用



2.Frigolet ME, Gutiérrez-Aguilar R. [The Role of the Novel Lipokine Palmitoleic Acid in Health and Disease](#). Adv Nutr. 2017 Jan 17;8(1):173S-181S.



沙棘果的健康作用—— ω -7脂肪酸

食物	棕榈油酸占总脂肪酸%	g/100 g 总脂肪酸FAs
鲑鱼（三文鱼）	6%	6
鱼肝油	7%	7
澳洲坚果油（macadamia oil）	17%	17
沙棘	32-42%粗果油	32-42粗果油
其他橄榄油、巧克力、鸡蛋	含量较低	

人类血浆中反式棕榈油酸（16:1t7）0.02-0.55%，血浆中棕榈油酸占大约1%

膳食因素如碳水化合物、蛋白质可促进血液中棕榈油酸水平增高



2.Frigolet ME, Gutiérrez-Aguilar R.[The Role of the Novel Lipokine Palmitoleic Acid in Health and Disease](#). Adv Nutr. 2017 Jan 17;8(1):173S-181S.



沙棘油的脂肪酸种类及含量

立陶宛：2016-2017年采收的沙棘全果油

脂肪酸类别	脂肪酸种类	野生 (g/kg)	栽培 (g/kg)
饱和脂肪酸 (SFA)	棕榈酸 (16:0)	227.2 ± 0.65	223.1 ± 2.39
	十八烷酸 (18:0)	13.25 ± 0.33	17.86 ± 0.44
	二十烷酸 (20:0)	2.81 ± 0.00	3.72 ± 0.71
单不饱和脂肪酸 (MUFA)	棕榈油酸 (16:1 n-7)	185.0 ± 1.37_a	134.6 ± 0.50 _b
	油酸 (C18:1 n-9)	255.5 ± 0.30 _b	264.1 ± 0.80 _a
	异油酸(C18:1 n-7)	65.61 ± 0.30_a	56.52 ± 1.10 _b
多不饱和脂肪酸 (PUFA)	油酸 (C18:2 n-6)	127.0 ± 2.22 _b	163.5 ± 0.16 _a
	α-亚麻酸 (C18:3 n-3)	100.3 ± 0.23 _b	109.8 ± 0.30 _a
	二十二碳四烯酸 (C22:4n-6)	3.90 ± 0.11 _a	4.41 ± 0.31 _a
总SFA		250.1 ± 0.61 _b	253.9 ± 2.30 _a
总UFA		747.0 ± 1.10	744.3 ± 3.33
总MUFA		512.7 ± 3.53 _a	463.4 ± 0.82
总PUFA		234.3 ± 1.90 _b	280.9 ± 0.50 _a
PUFAs/SFAs		0.937 ± 0.03 _b	1.106 ± 0.03 _a
ω-6/ω-3		1.271 ± 0.02 _b	1.490 ± 0.03 _a

野生品种
棕榈油酸
(16:1 n-7)
含量高!





Sea buckthorn oil for the prevention and treatment of chronic diseases

-- -- Animal experiments and clinical population studies

Which trials leading?

Food or food ingredients, population based or clinical trials should leading....

10 animal experiments are effective, only one human study is effective

Fruits are meant for people to eat,
and food also





Population based randomized controlled study

- Randomized clinical trials
- Design :
 - Control group
 - Randomized grouping
- Relation between Researcher & subjects
 - Single blinded
 - Double blinded
 - Triple blinded





Examples

1. More berry intake is beneficial for health

Daily intakes berries

健康成人；
超重、肥胖

浆果餐31

对照餐30





Healthy adults

Long period intervention observation: 20w

- Sea buckthorn
- Bilberry
- Raspberry
- Blueberry



Turku University
 Professor Kallio H



Decrease ALT levels of overweight /obese subjects

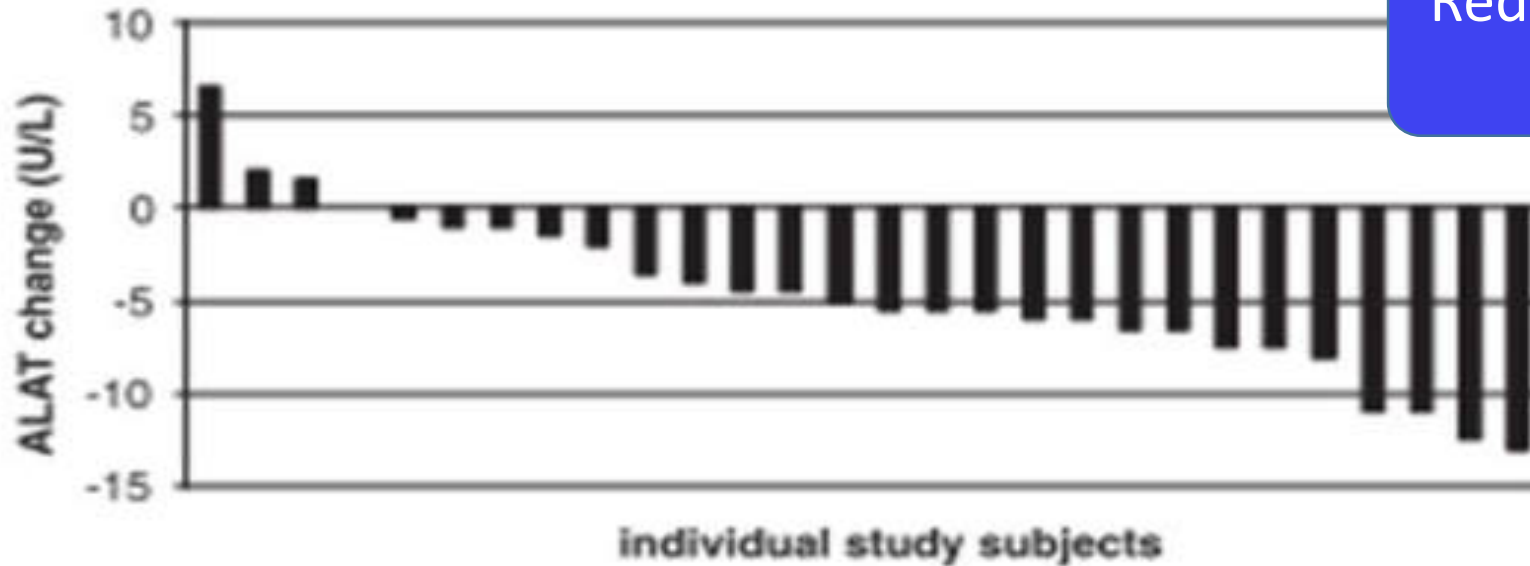
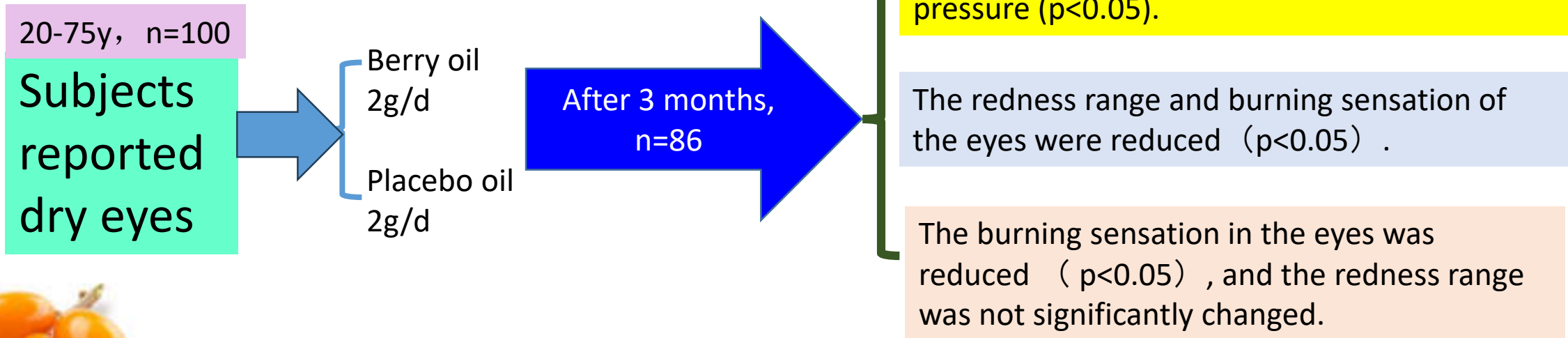


Figure 3 Changes in alanine aminotransferase (ALAT) levels during intervention period of individual study subjects in berry group.





2. The effect of oral sea buckthorn oil on individuals with dry eyes





2. T

TABLE 2 Fatty acids, carotenoids, and tocopherols in the daily dose of SB and placebo oil¹

	SB	PL
Fatty acid	<i>mg/ 2 g oil</i>	
8:0		884 ± 11
10:0		733 ± 4
12:0		1 ± 0
14:0	2 ± 0	2 ± 0
16:1(n-7)	346 ± 48	
16:0	338 ± 47	
18:2(n-6)	245 ± 34	
18:3(n-3)	149 ± 21	
18:1(n-9)	316 ± 45	
18:1(n-7)	108 ± 15	
18:0	31 ± 4	
20:0	6 ± 1	
Carotenoids	1.8 ± 0.0	
α-Tocopherol	6.0 ± 0.4	0.2 ± 0.0
γ-Tocopherol	0.8 ± 0.1	

¹ Values are means ± SD, n = 8 (SB) or 3 (PL).

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(p<0.05) .

the eyes was
and the redness range
nged.

20-75y, n=100

Subjects
reported
dry eyes

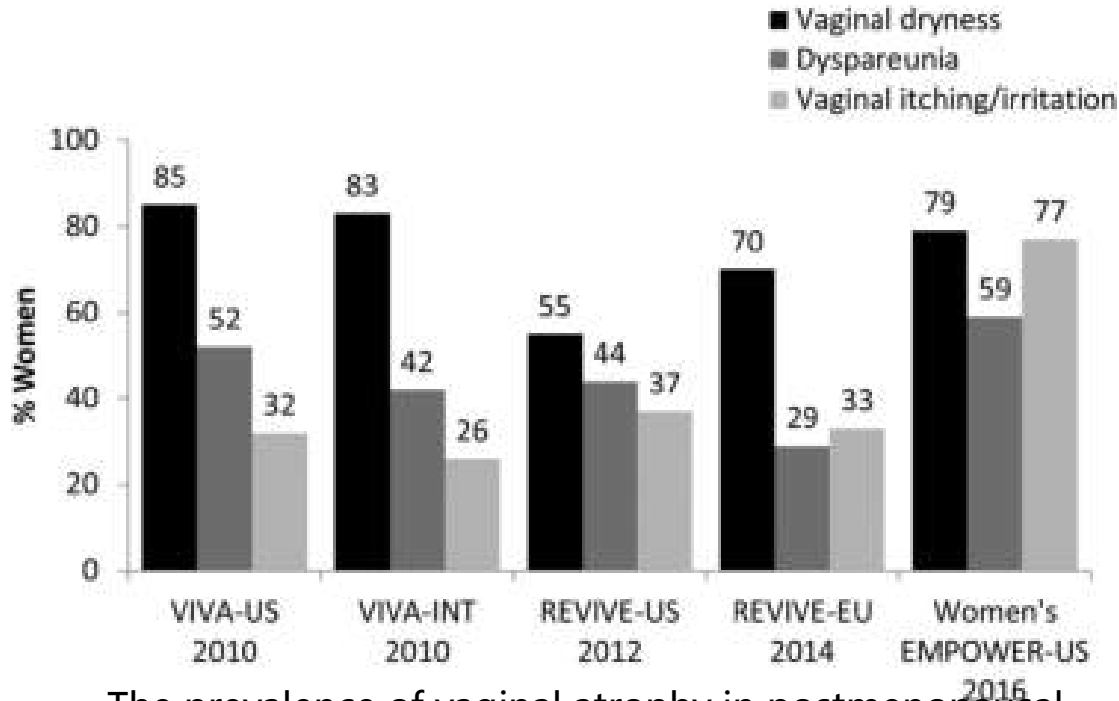




3. The effect of oral sea buckthorn oil on vaginal atrophy in postmenopausal women

Vaginal atrophy rate in postmenopausal women in Finland & USA, 43%

芬兰进行的一项随机双盲对照试验



The prevalence of vaginal atrophy in postmenopausal women in the United States(%)



受试者：55-75岁绝经期后女性

纳入标准：有中度或重度阴道粘膜干燥、灼烧、瘙痒的经历；

排除标准：采用雌激素治疗者





3. The effect of oral sea buckthorn oil on vaginal atrophy in postmenopausal women

Vaginal atrophy rate in postmenopausal women in Finland & USA, 43%



A randomized double-blind controlled trial conducted in Finland

Subject: Postmenopausal women aged 55-75;

Inclusion criteria: experience of moderate or severe vaginal mucosal dryness, burning, and itching;

Exclusion criteria: Patients treated with estrogen;



3. The effect of oral sea buckthorn oil on vaginal atrophy in postmenopausal women

The subjects consumed 3g of sea buckthorn oil or placebo daily for 3 months

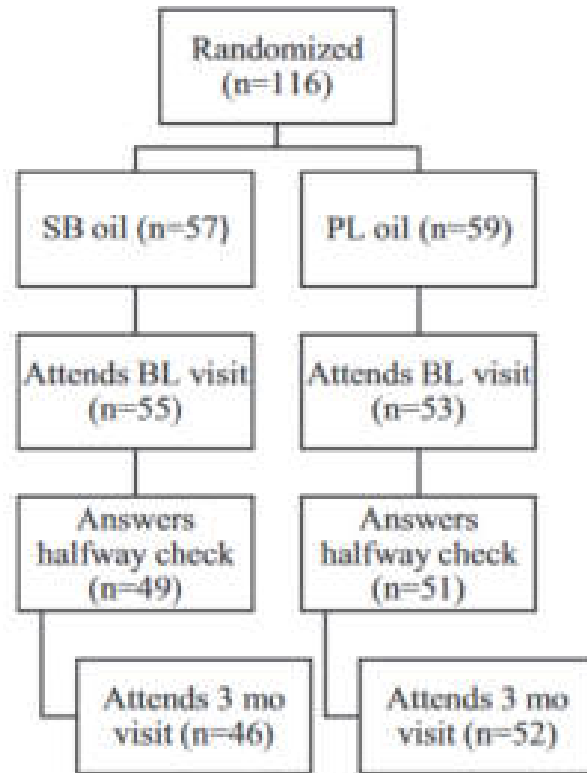


Fig. 1. Flow of participants during the study.



1) The integrity of vaginal mucosa has been significant protected OR3.14, 95CI (1.11-8.95)

P.S. Larmo et al. / Maturitas 79 (2014) 316–321

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Table 1
Changes in the vaginal elasticity, fluid volume, pH-score, epithelial integrity and moisture among the ITT participants during the three month intervention.^{a,b}

	No change or deterioration, n (%)		Improvement, n (%)		Odds ratio	95% CI
	SB	PL	SB	PL		
Elasticity	28 (97)	37 (74)	14 (33)	13 (26)	1.48	0.53–4.19
Fluid volume	37 (98)	40 (80)	5 (12)	5 (10)	1.50	0.32–7.04
pH-score	33 (70)	38 (77)	9 (21)	12 (24)	0.92	0.34–2.51
Epithelial integrity	37 (94)	43 (84)	5 (11)	8 (16)	3.14	1.11–8.95
Moisture	29 (98)	40 (80)	3 (7)	10 (20)	2.11	0.74–6.02

^a Values are n (%) of participants.

^b Logistic regression with baseline value as covariate was used for the analysis of group differences.

^c SB, n=42; PL, n=50.

2) Increase vaginal health index somehow, (p=0.08)

Table 2
Vaginal health index, pH and moisture of vaginal mucosa among ITT participants at baseline and the change from baseline to end of the intervention at three months.^{a,b}

	SB ^c		PL		P-value
	0 mo	3 mo–0 mo	0 mo	3 mo–0 mo	
Vaginal health index	11.9 (2.9)	0.8 (2.8)	12.2 (2.5)	–0.1 (2.0)	0.08
pH	6.6 (1.1)	–0.2 (1.0)	6.6 (1.1)	–0.2 (1.1)	1.00
Moisture test, mm/min	2.4 (1.0)	–0.9 (1.1)	2.6 (1.4)	–1.0 (1.5)	0.62

^a Values are means (SD).

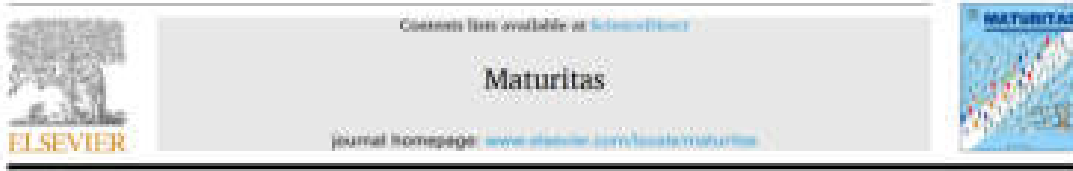
^b Two-way ANCOVA with baseline measure as covariate was used for the analysis of group differences.

^c SB, n=42–54; PL, n=49–55.



4. Sea buckthorn oil—Efficacy and safety of a new vaginal gel for the treatment of symptoms associated with vulvovaginal atrophy in postmenopausal women

Conducted in Italian, 2021



Efficacy and safety of a new vaginal gel for the treatment of symptoms associated with vulvovaginal atrophy in postmenopausal women: A double-blind randomized placebo-controlled study

Francesco De Seta^{1,2,3}, Salvatore Caruso⁴, Giovanni Di Lorenzo⁵, Federico Romano⁶, Mariateresa Mirandola¹, Rossella E. Nappi¹

¹ Institute for Maternal and Child Health, IRCCS Carlo Gemelli, via dell'Esilio 83/1, 00157 Rome, Italy
² Department of Medicine, Surgery and Health Sciences, University of Pavia, Pavia, Italy
³ Department of General Surgery and Medical Surgical Specialties, Research Group for Senology, University of Catania, via S. Sofia, 78 - 95125 Catania, Italy
⁴ Research Center for Reproductive Medicine, Gynecological Endocrinology and Menopausal, Obstetrics and Gynecology Unit, IRCCS G. Monze Foundation, Department of Clinical, Surgical, Diagnostic and Pediatric Sciences, University of Pavia, Viale Gemelli 10/g, 18, 27100 Pavia, Italy

Give 5mL active gel every night during sleep

Ingredients:

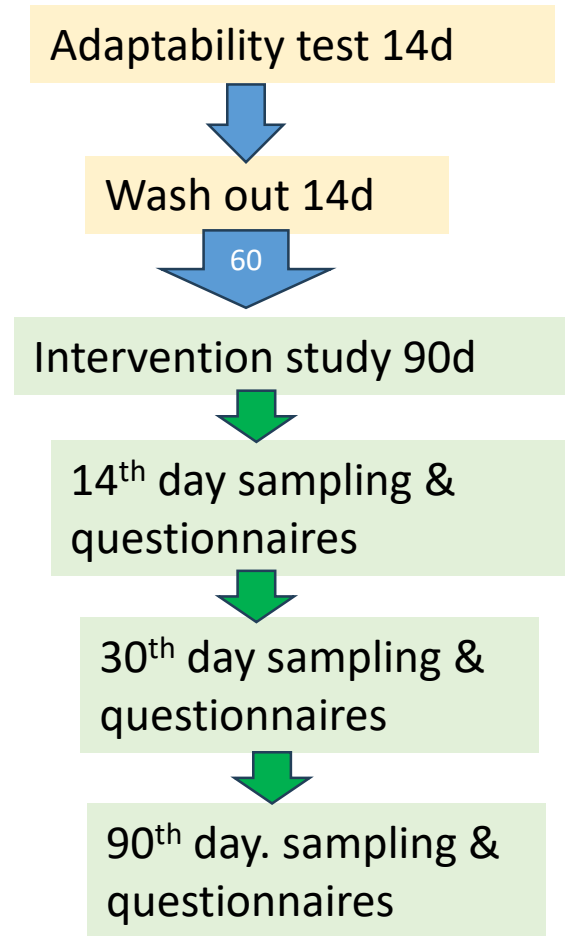
Sea buckthorn oil;

Aloe;

18 β - glycyrrhetic acid;

Hyaluronic acid;

Glycogen





4. Sea buckthorn oil—Efficacy and safety of a new vaginal gel for the treatment of symptoms associated with vulvovaginal atrophy in postmenopausal women

Conducted in Italian, 2021

Ingredients:

Sea buckthorn oil;

Aloe;

18 β - glycyrrhetic acid;

Hyaluronic acid;

Glycogen

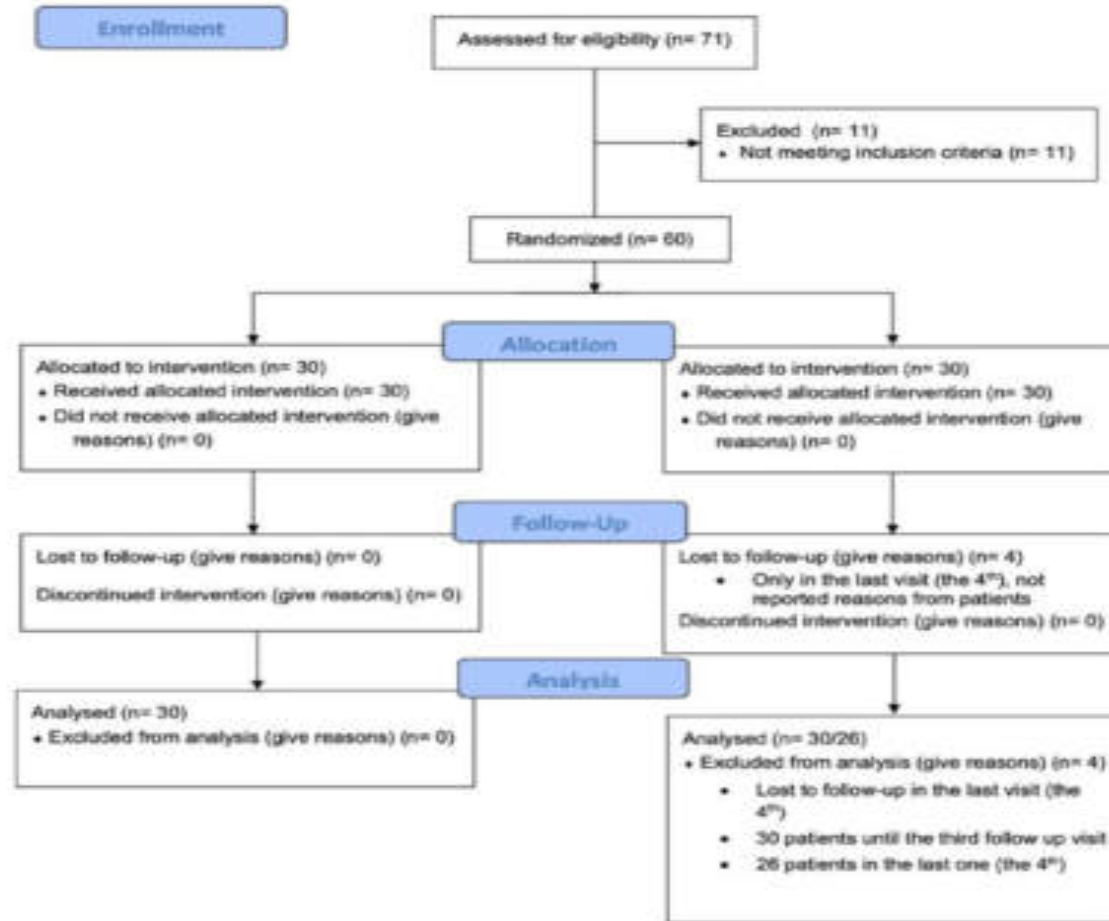


Fig. 1. CONSORT Flow Diagram.





4. Sea buckthorn oil—Efficacy and safety of a new vaginal gel for the treatment of symptoms associated with vulvovaginal atrophy in postmenopausal women



Result:

- 1) Effective in reducing vaginal pain, difficulty during sexual intercourse, and vaginal pH;
- 2) On the 90th day, the vaginal health index showed significant improvement ($P < .0001$);
- 3) Various symptoms of vulvovaginal atrophy (vaginal dryness, vaginal itching, burning sensation) were reduced in weeks 2 and 4, as well as at the end of the study ($P < 0.0001$).
- 4) After treatment, the female sexual function in the experimental group improved, with significant increases in scores and total scores in all indexes ($P < 0.001$).



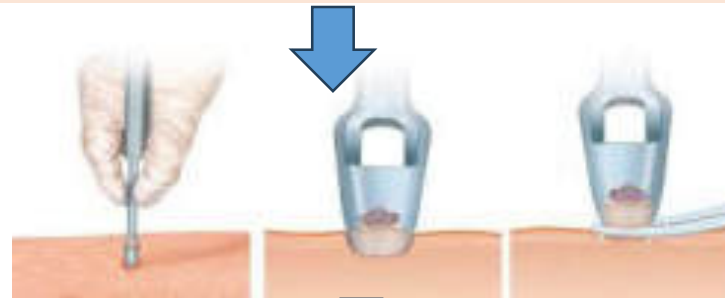


5. The effect of sea buckthorn oil (berry oil & seed oil)on fatty acid composition of glycerophospholipids in the skin

Conducted by Finland- Randomized double-blind placebo-controlled parallel clinical trial

Sea buckthorn fruit oil soft capsules, sea buckthorn seed oil soft capsules, placebo (paraffin oil capsules), stored in a refrigerator at 4 ° C

Patients with atopic dermatitis(n=22) randomized into 3 groups, oral intake 10 capsules (5g oil/d) for 4 months, and perform skin biopsy and skin puncture biopsy (diameter 4mm; thickness 6mm)



- 1) After Washing with physiological saline, the fatty acid composition of glycerophospholipids stored in the skin at 70 ° C.
- 2) Plasma collected

Fatty acid composition of glycerophospholipids in the skin





5 The effect of sea buckthorn oil (berry oil & seed oil) on fatty acid composition of glycerophospholipids in the skin

Sea buckthorn seed oil group:

The proportion of DPA (docosapentaenoic acid) , glycerophospholipids (22:5n-3) in skin slightly increased;

The proportion of palmitic acid (16:0) slightly decreased (0.05<P<0.1);

The levels of other fatty acids remain stable.

The results indicate that the fatty acid composition of skin glycerophospholipids has a good buffering effect on short-term dietary adjustments





6. Trans fatty acids concerns- a pilot study

- Controversy:

- Cis-palmitoleic acid (9-hexadecenoic acid; 16:1n-7c), named fatty factor, it had reported to improve insulin sensitivity, anti-inflammation, and regulate lipoprotein profile;
- Trans palmitoleic acid (16:1n-7t) is associated with a lower/ higher ? incidence rate of type 2 diabetes.

- Question:

- What is the effect of supplements containing cis - and trans palmitoleic acid with increasing dosage?





6. Supplementation with Seabuckthorn Oil Augmented in 16:1n-7t Increases Serum Trans-Palmitoleic Acid in Metabolically Healthy Adults

- A Randomized Crossover Dose-Escalation Study in Netherland
 - Thirteen participants (7 women and 6 men; age 48 ± 16 y, BMI 30.4 ± 3.7 kg/m²) into 2 groups:
 - Unmodified sea buckthorn oils relatively high in 16:1n-7c (380, 760, and 1520 mg 16:1n-7c/d)
 - Sea buckthorn oils augmented in 16:1n-7t (120, 240, and 480 mg 16:1n-7t/d).
 - Each of the 3 escalation doses was provided for 3 wk, with a 4-wk washout period between the 2 supplements.
 - At the end of each dose period, fasting blood samples were used to determine the primary outcomes (serum concentrations of the PLFAs 16:1n-7t and 16:1n-7c) and the secondary outcomes (glucose homeostasis, serum lipids, and clinical measures).
 - Trends across doses were evaluated using linear regression.





6. Supplementation with Sea buckthorn Oil Augmented in 16:1n-7t Increases Serum Trans-Palmitoleic Acid in Metabolically Healthy Adults

Inclusion criteria:

18-70 years old; BMI (unit: kg/m²) 25-40; Fasting blood glucose \leq 120mg/dL; Normal blood pressure (blood pressure < 140/90 mmHg), with or without medication intake; Normal thyroid (with or without medication treatment for \geq 6 months), kidney, liver, and gastrointestinal clinical blood measurements.

Exclusion criteria:

Use of supplements containing fish oil or other lipid supplements within 3 months after randomization; Habitual daily consumption of \geq 3 servings of cheese, whole milk, or whole yogurt (16:1n-7t as the main dietary source); Alcohol intake > 7 alcoholic beverages per week; Unable or difficult to take medication; Diagnosed as type 1 or type 2 diabetes and/or taking hypoglycemic drugs; Taking drugs known to affect lipid metabolism; And hormone replacement therapy.

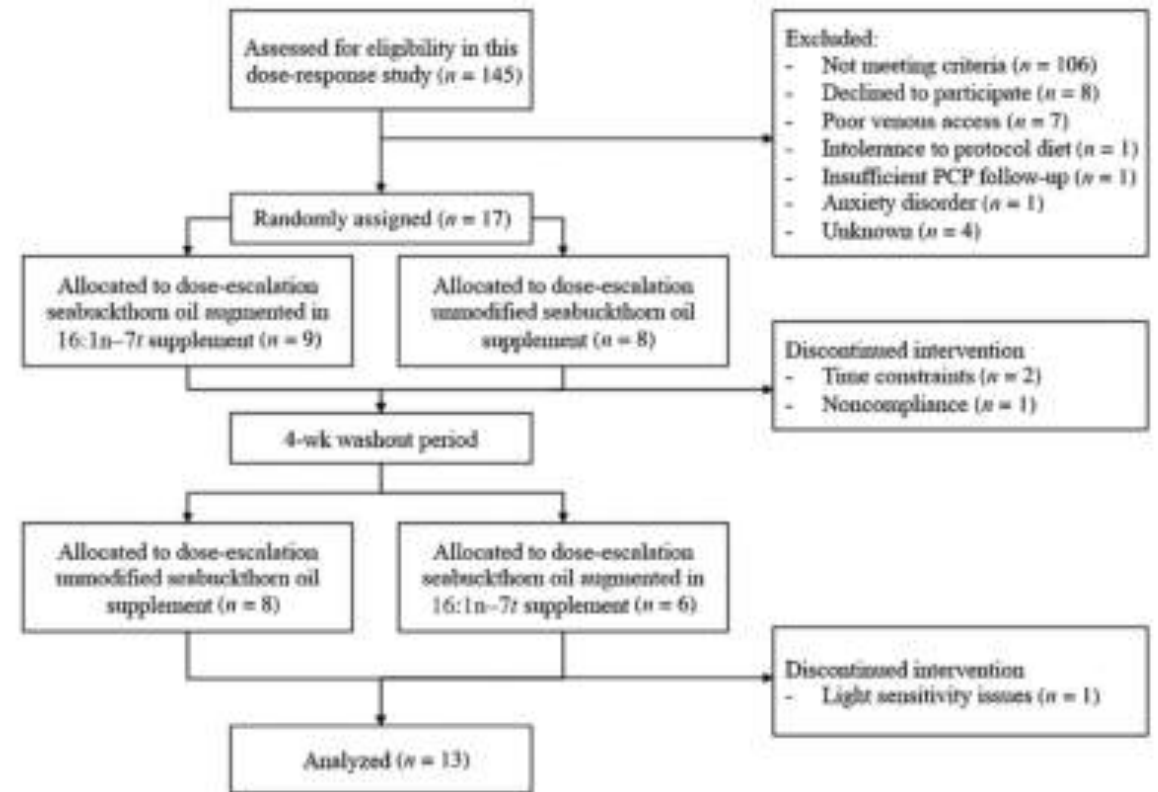


FIGURE 1 Flow diagram of the metabolically healthy adults supplemented with seabuckthorn oil augmented in 16:1n-7t and unmodified seabuckthorn oil. PCP primary care provider.



6. Supplementation with Sea buckthorn Oil Augmented in 16:1n-7t Increases Serum Trans-Palmitoleic Acid in Metabolically Healthy Adults

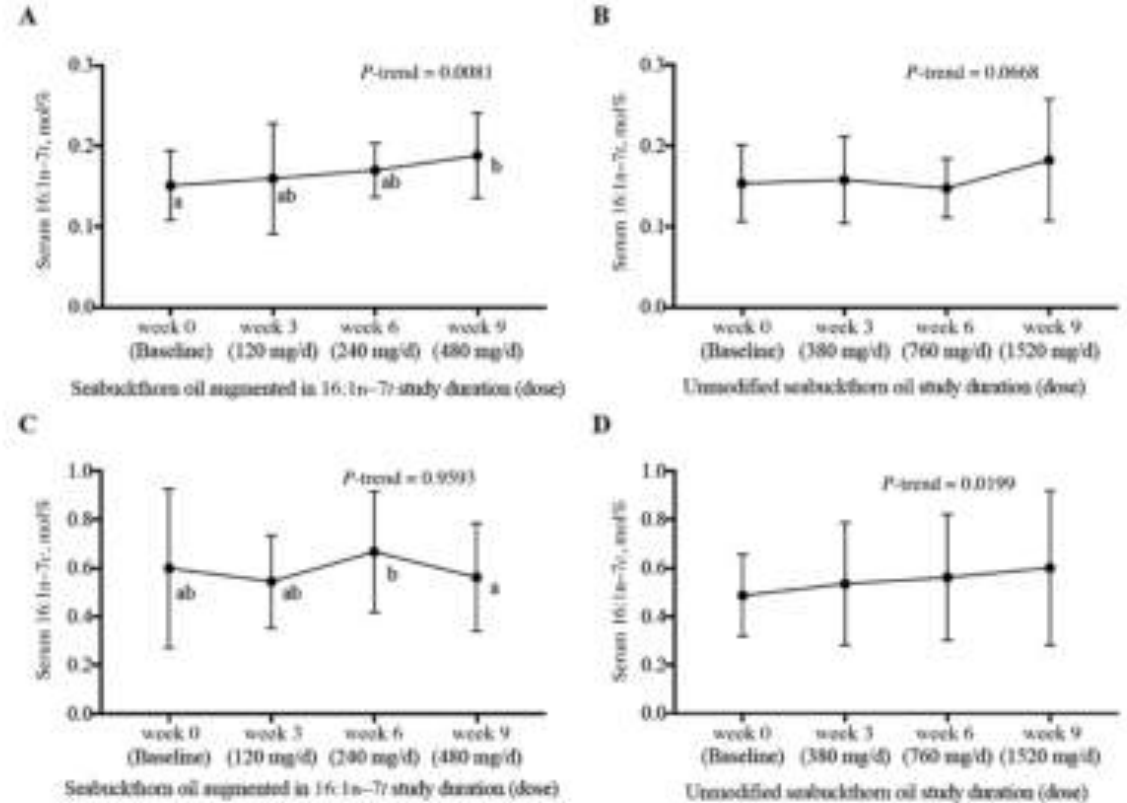
Compared with baseline:

1) Supplementation with sea buckthorn oil augmented in 16:1n-7t increased phospholipid 16:1n-7t by 26.6% at the highest dose ($P = 0.0343$).

2) Supplementation with unmodified sea buckthorn oil resulted in a positive trend across the dose-escalations ($P\text{-trend} = 0.0199$).

3) No significant effects of either supplement were identified on blood glucose, insulin, lipids, or other clinical measures, although this dosing study was not powered to detect such effects.

4) No carryover or adverse effects were observed.



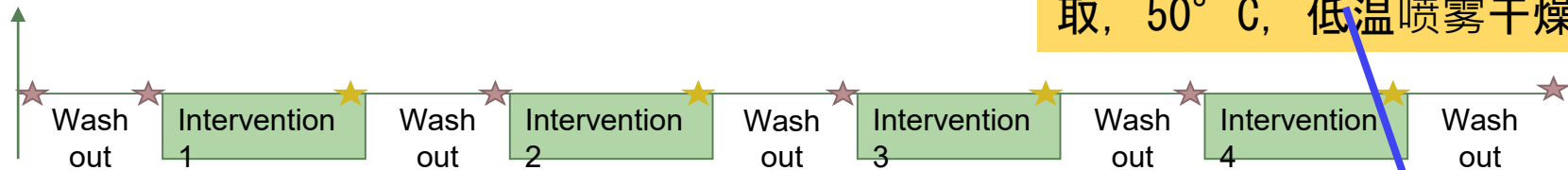
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FIGURE 2 Fasting serum phospholipid fatty acid concentrations at the end of each supplement phase in metabolically healthy adults. (A) 16:1n-7t in the seabuckthorn oil augmented in 16:1n-7t; (B) 16:1n-7c in the unmodified seabuckthorn oil; (C) 16:1n-7c in the seabuckthorn oil augmented in 16:1n-7t; (D) 16:1n-7c in the unmodified seabuckthorn oil. Values are means \pm SDs in mol%. (A, C, $n = 13$; B, D, $n = 13$ in weeks 0, 6, and 9; $n = 12$ in week 3 owing to limited sample volumes). Labeled means without a common letter differ, $P < 0.05$.



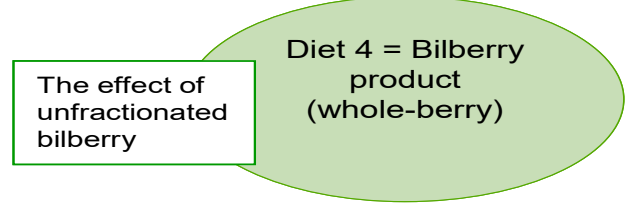
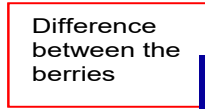
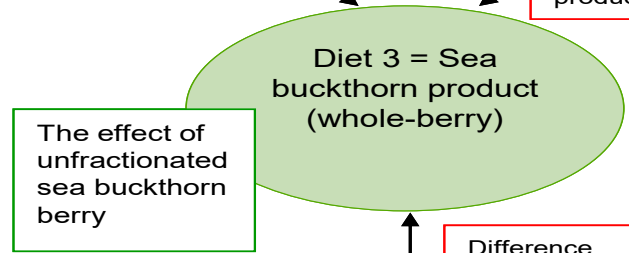
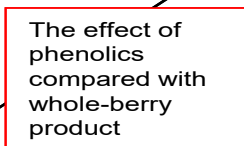
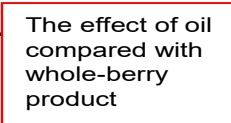
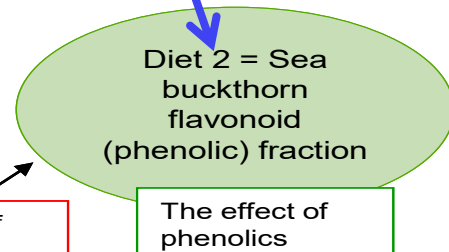
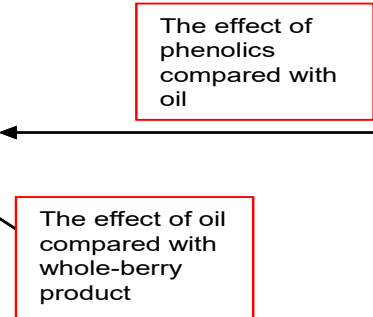
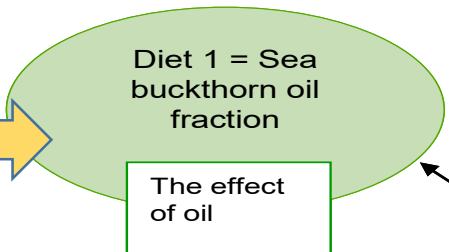
7. The health effects of different edible parts of sea buckthorn

沙棘提取物：50%乙醇提取，50° C，低温喷雾干燥



Intervention 35 days, wash out 30 days
* Sampling point.

Sea buckthorn oil



Overweight & obesity
BMI 26–34 kg/m²
N=119
80 subjects meet metabolic syndrome standards by IDF (2006)



RCT:





7. The health effects of different edible parts of sea buckthorn

	Average \pm s.d.		Absolute change ^e	Significance of change ^d
	SB berries			
	Wash-out ^a	Berries		
Waist circumference (cm)	95.4 \pm 7.2	94.3 \pm 7.8	-1.1 \pm 3.0	0.008
Glucose (mmol/l)	5.1 \pm 0.3	5.0 \pm 0.4	-0.1 \pm 0.3	0.002
GHbA _{1c} (%) ^a	5.2 \pm 0.3	5.4 \pm 0.3	0.2 \pm 0.3	0.000
TNF- α (pg/ml) ^a	4.7 \pm 1.7	4.5 \pm 1.7	-0.2 \pm 1.5	0.023

	Average \pm s.d.		Absolute change ^e	Significance of change ^d
	SB extract			
	Wash-out ^a	Berries		
GHbA _{1c} (%) ^a	5.1 \pm 0.4	5.3 \pm 0.3	0.1 \pm 0.3	0.000
ICAM-1 (ng/l) ^a	184.0 \pm 29.9	178.3 \pm 31.4	-6.1 \pm 24.6	0.028
TNF- α (pg/ml) ^a	4.8 \pm 1.5	4.5 \pm 1.7	-0.3 \pm 1.2	0.000

	Average \pm s.d.		Absolute change ^e	Significance of change ^d
	SB berry oil			
	Wash-out ^a	Berries		
Waist circumference (cm)	95.7 \pm 8.2	94.5 \pm 7.2	-1.2 \pm 3.8	NS (0.077)
GHbA _{1c} (%) ^a	5.2 \pm 0.4	5.3 \pm 0.3	0.2 \pm 0.3	0.000
hs-CRP ^b (mg/l)	2.0 \pm 1.7	2.4 \pm 2.4	0.5 \pm 5.6	0.006
VCAM-1 (ng/ml) ^a	882.1 \pm 128.9	814.8 \pm 158.1	-66.1 \pm 170.0	0.001
Adiponectin (μ g/ml) ^a	26.5 \pm 13.5	24.2 \pm 11.4	-2.4 \pm 6.5	0.004

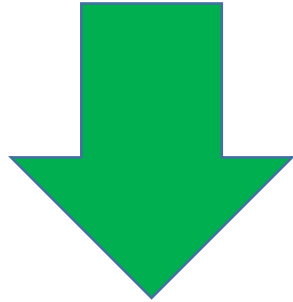
- Berry has a significant effect on waist circumference, blood glucose, glycated hemoglobin, and TNF - α ;
- The extract has a significant effect on glycated hemoglobin, intercellular adhesion molecules ICAM-1, and TNF - α ;
- Sea buckthorn berry oil has a significant effect on waist circumference, glycated hemoglobin, high-sensitivity C-reactive protein, VCAM-1, and adiponectin

P<0.05



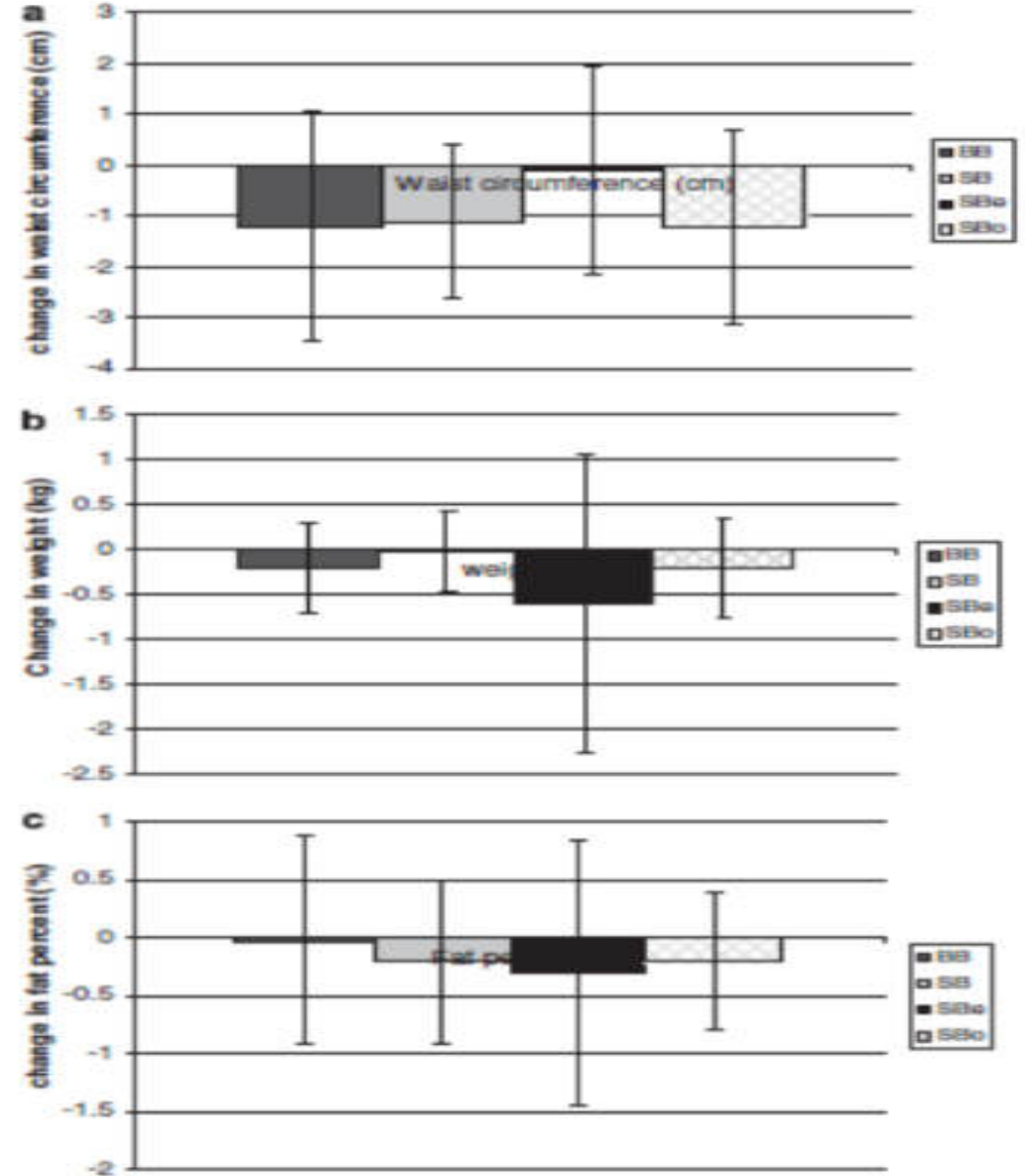
Eating sea buckthorn is more beneficial for individuals at metabolic risk

EJCN



AJCN

Conclusion: Berry intake has overall metabolic effects, which depend on the cardiometabolic risk profile at baseline. This trial was registered at clinicaltrials.gov as NCT01860547. *Am J Clin Nutr* 2013;98:941-51.





8. Health effect of sea buckthorn fruit on hypercholesterolemia & prediabetes

Double blind randomized clinical trial

Subjects with hypercholesterolemia, n=120

A : sea buckthorn fruit puree


B : placebo



Article

Dietary Supplementation with Sea Buckthorn Berry Puree Alters Plasma Metabolomic Profile and Gut Microbiota Composition in Hypercholesterolemia Population

Kang Chen ¹, Fangfei Zhou ², Jian Zhang ², Pin Li ², Yumei Zhang ^{2,3,*} and Baoru Yang ^{1,4,*}



350 people reported hyperlipidemia

National natural scientific funding of China



Thanks!

