

# **Nutrition and Health Benefits of Rice Bran Oil**

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# Fats are needed for life

- Energy 9 K Cals/g – Low fat intakes in chronic energy deficiency
- Essential Fatty acids- LA(n6) ALNA(n3)
- Produce bioactive molecules
- Absorption of Fat soluble vitamins
- Cell membrane function
- Components of Signalling pathways
- Texture, taste and satiety

# A primer on dietary fats (Lipids)

## Major Components (> 95%)

- Triacylglycerol's ( Triglycerides)

## Minor Components

- Mono and Diacylglycerols (smaller amounts)
- Phospholipids, Glycolipids
- Non Saponifiable / Non Glyceride fractions (<4%)-carotenoids,tocotrienols,oryzanol etc

**Table 6.2****Approximate fatty acid composition of dietary fats and oils consumed in India (% of total fatty acids)**

<b>Fats/ oils</b>	<b>SFAs*</b>	<b>MUFAs**</b>	<b>LA</b>	<b>ALA</b>
<b>High (medium chain) SFAs</b>				
Coconut	92 <sup>a, d</sup>	6	2	-
Palm kernel	83 <sup>b, d</sup>	15	2	-
Butter/Ghee	68 <sup>c, e, f</sup>	29	2	1
<b>High SFAs &amp; MUFAs</b>				
Palmolein	39	46	11	<0.5
<b>High MUFAs &amp; Moderate LA</b>				
Groundnut <sup>i</sup>	19	41	32	<0.5
Rice bran <sup>h</sup>	17	43	38	1
Sesame <sup>h</sup>	16	41	42	<0.5
<b>High LA</b>				
Cottonseed <sup>h</sup>	24	29	48	1
Corn <sup>h</sup>	12	35	50	1
Safflower <sup>h</sup>	9	13	75	-
Sunflower <sup>h</sup>	12	22	62	-
<b>LA &amp; ALA</b>				
Soybean <sup>h</sup>	14	24	53	7
Canola <sup>h</sup>	6	60 <sup>j</sup>	22	10
Mustard/rapeseed <sup>h</sup>	4	65 <sup>k</sup>	15	14
Flaxseed	10	21	16	53
<b>High TFAs</b>				
Vanasapti <sup>h</sup>	46	49 <sup>g</sup>	4	-

**Table 8.1 Recommendations for dietary fat intake in children**

Age/Sex/physiological groups	Physical activity	Minimum level of Total fat (%E)	Fat from foods other than visible fats <sup>g</sup> %E	Visible fat <sup>h</sup>	
				%E	g/p/d
Adult Man	Sedentary	20 <sup>a</sup>	10	10	25
	Moderate				30
	Heavy				40
Adult Woman	Sedentary	20 <sup>a</sup>	10	10	20
	Moderate				25
	Heavy				30
	Pregnant women	20 <sup>b</sup>	10	10	30
	Lactating women				30
					30
Infants	0 – 6 months	40-60 <sup>c</sup>	Human milk <sup>i</sup>		
	7- 24 months	35 <sup>c,d</sup>	10 <sup>e</sup>	25	
Children	3-6 years	25 <sup>c, f</sup>	10	15	25
	7-9 years				30
Boys	10 – 12 years				35
	13 – 15 years				45
	16 – 18 years				50
Girls	10 – 12 years				35
	13 – 15 years	40			
	16 – 18 years	35			

Reference <sup>a</sup>6.5 <sup>b</sup> 6.11 <sup>c</sup> 6.9

<sup>d</sup> gradually reduce depending on physical activity <sup>e</sup> Human milk /infant formula+ complementary foods

<sup>f</sup> depending on physical activity, <sup>g</sup> if higher than 10%E, visible fat requirement proportionately reduces

<sup>h</sup> cooking oils, butter, ghee and margarine

<sup>i</sup> infant formulae/ milk substitutes should mimic contents of fat and fatty acids in human milk including arachidonic and docosahexaenoic acid.

# RDI of Fatty acids vs RBO Fatty acid composition

- 10% of energy from visible fat @ 2000 Kcals = 200 Kcals
- @ 9Kcals/ Gm Fat = 22Gm (RDA 25Gms)
- 1/3 = Saturated Fat = 8Gm
- RBO 6.25 Gm/ 25 Gm
- 1/3 = MUFA = 8 Gms
- RBO 9.5 Gm/ 25Gms
- 1/3 = PUFA = 8 Gms – RBO 9.25 / 25 Gms

# RDI of PUFA vs RBO PUFA composition

- Linoleic Acid (LA) /  $\omega$  6 (18 : 3 n6)
- RDI Approx 6.5 Gms / 25 Gms
- RBO ; 8.75 Gms / 25 Gms
- $\alpha$  Linolenic Acid (ALNA) /  $\omega$  3 (18:4- n3)
- RDI Approx 1.5 Gms
- RBO ; 0.6 Gms / 25 Gms

## PUFA Intake in different populations (gm/d)

<b>Population</b>	<b>n-6</b>	<b>n-3</b>	<b>n-6/n-3</b>
<b>India</b>	<b>20</b>	<b>0.5</b>	<b>40</b>
<b>USA</b>	<b>14</b>	<b>1.4</b>	<b>10</b>
<b>UK</b>	<b>14</b>	<b>1.9</b>	<b>7</b>
<b>Japan</b>	<b>26</b>	<b>7.0</b>	<b>4</b>
<b>Eskimo</b>	<b>5</b>	<b>5</b>	<b>1</b>



**TABLE- 6.5 RECOMMENDATIONS FOR TYPE OF VISIBLE FAT #**

<p>1.</p>	<p><b>Use correct combination / blend of 2 or more vegetable oils (1:1)##</b></p> <p><i>Oil containing LA + oil containing both LA and ALA (Table 6.1, Columns 8 &amp; 9)*</i></p> <p>Groundnut / Sesame<sup>a</sup> / Rice bran<sup>b</sup> / Cottonseed + Mustard/ Rapeseed **          Groundnut /Sesame<sup>a</sup> / Ricebran<sup>b</sup> / Cottonseed + Canola          Groundnut / Sesame<sup>a</sup> / Rice bran<sup>b</sup> / Cottonseed + Soyabean          Palmolein<sup>c</sup> + Soyabean          Safflower / Sunflower + Palm oil/Palmolein<sup>c</sup> + Mustard/ Rapeseed**</p> <p><i>Oil containing high LA + oil containing moderate or low LA *** Table 6.4 Column 8 )</i></p> <p>Sunflower / Safflower + Palmolein<sup>c</sup> / Palm oil<sup>c</sup> / Olive          Safflower / Sunflower + Groundnut / Sesame<sup>a</sup> / Ricebran<sup>b</sup> / cottonseed</p>
<p>2.</p>	<p><b>Limit use of butter/ghee <sup>d</sup> (Table 6.1, Column 2)</b></p>
<p>3.</p>	<p><b>Avoid use of PHVO as medium for cooking / frying (Table 6.1 columns 2 &amp; 4 )</b></p>
<p>4.</p>	<p><b>Replacements for PHVO (Table 6.1, column 4)</b></p> <p><b>Frying :</b> oils which have higher thermal stability -- palm oil<sup>c</sup> / palmolein<sup>c</sup>, sesame<sup>a</sup>, ricebran<sup>b</sup>, cottonseed -- single / blends ( home /commercial)</p> <p><b>Bakery fat, shortening, Mithai / Indian sweets etc</b> -- Food applications which require solid fats : coconut oil/ palm kernel oil/ palm oil / palmolein/ palm stearin and / their solid fractions and / their blends</p>

Diet surveys by the National Nutrition Monitoring Bureau show that daily intake of visible fats in rural India range 6-22g

In the urban middle and upper income groups the daily intake of visible fat ranges between 22-45g / p / d and total fat in their diets furnish 20-33%E.

# Basis for RDA for dietary fats for Indians

The recommendations are directed towards meeting the requirements for optimal fetal and infant growth and development,

Combating chronic energy deficiency (children and adults) and

Diet Related-NCD in adults.

# OUR LIPID PROFILES

# Our Lipid Profiles are Different

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- ❖ **High triglyceride.**
- ❖ **Low concentrations of high density lipoprotein (HDL)**
- ❖ **The LDL particle size tends to be smaller (small, dense LDL)**
- ❖ **Small particle size (LDL-3) increases the susceptibility to oxidation**
- ❖ **More atherogenic than the larger ones**

## Metabolic Syndrome – ? An adaptive epigenetic phenomenon gone wrong

- ❖ **20-25% of urban South Asians have evidence of the metabolic syndrome**
- ❖ **2X risk of all cause mortality and risk of cardiovascular mortality.**
- ❖ **Insulin resistance was reported to be present in nearly 30% of children and adolescents in India**

# Effect of SFA on TC:HDL-C

*Michal and Mozzafarian Lipids 2010*

- Non significantly affected by consumption of Myrsitic / Palmitic
- (RBO: M 0.6% , P 21.5%)
- Non significantly decreased by stearic Acid (RBO: 2.9%)
- Significantly decreased by Lauric Acid
- \* *Data in parenthesis is not part of original publication*

# Effect of replacement of SFA on TC:HDL-C

*Michal and Mozzafarian Lipids 2010*

- 5% En ( $\approx$  10 gm) with PUFA = 10% CHD risk reduction (RBO: 9 Gm/ 25 Gms)
- Replace with CHO = No CHD risk reduction
- Replace with MUFA= uncertain effects
- *Data in parenthesis is not part of original publication*



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- ❖ **Stearic acid (SFA) has no effect on cholesterol metabolism since it can be converted to oleic acid (RBO: 2.9%)**
  - ❖ **Intake of SFA is independently correlated with high CRP**
  - ❖ *Data in parenthesis is not part of original publication*
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Abstract. *Willett WC . Dietary fats and coronary heart disease (Review). J Intern Med 2012; 272: 13–24*

- All lines of evidence indicate that specific dietary fatty acids play important roles in the cause and the prevention of CHD, but total fat as a percent of energy is unimportant.
- Trans fatty acids from partially hydrogenated vegetable oils have clear adverse effects and should be eliminated.
- Modest reductions in CHD rates by further decreases in saturated fat are possible if saturated fat is replaced by a combination of poly- and monounsaturated fat, and the benefits of polyunsaturated fat appear strongest (RBO : 75%)
- \* *Data in parenthesis is not part of original publication*

Little or no benefit if SFA is replaced by carbohydrate, but will in part depend on the form of carbohydrate.

N-6 and N-3 PUFA are essential and reduce risk of heart disease

Ratio of N-6 to N-3 is not useful and can be misleading.

Reducing red meat and dairy products and increasing intakes of nuts, fish, soy products and nonhydrogenated vegetable oils (eg RBO) will improve the mix of fatty acids and have a markedly beneficial effect on rates of CHD.

*(info in parenthesis not part of publication)*

# Fat and Insulin Resistance

- Oleic acid (MUFA) may promote Insulin resistance while PUFA does not (FAO/WHO : Fats and Fatty acids in human nutrition: report of an expert consultation; FAO/WHO Geneva Switzerland, 2010)

# References

Recommended Dietary Guidelines for Indians ICMR 2010

Uauy R, Aro A, Clarke R, Ghafoorunissa *et al.* WHO Scientific Update on *trans* fatty acids: Summary and Conclusions Eur Jour Clin Nutr63, S68-S75, 2009 DOI:10.1038/ejcn.2009.15

Ghafoorunissa. Dietary fat and diet related chronic diseases: An Indian perspective. InTouch 7:2–6, 2005

Uauy R and Dangour AD. Fat and fatty acid requirements and recommendations for infants of 0–2 years and children of 2–18 years. Ann Nutr Metab 55:76-99, 2009. DOI: 10.1159/000228997

**NNMB Reports; National Institute of Nutrition ICMR**

# Clinical studies on RBO

*(Raghuram et al ;Nutr Rep Intl 1989)*

- 21 patients ( 40-55yrs ) with Hyperlipidemia (s. Chol > 225 mg/dl or s TG > 190 mg/dl)- randomised to Test / Control
- **Dietary RBO 30% of total calories**
- Significant reduction in serum Cholesterol after 15 days (247.3  $\pm$  6.60 to 204.0  $\pm$  6.60 )
- **After 30 days (182.7  $\pm$  8.44)**

# Clinical studies on RBO

- Significant reduction in serum Triglycerides after 15 days use (  $349.8 \pm 42.41$  to  $236.5 \pm 31.86$  )
- After 30 Days (  $212.9 \pm 20.04$  )
- No change in controls on other oils

# Effect of RBO on Lipid profiles and Insulin Resistance in T2DM

- Lipid Profiles improved but no effect on Insulin Resistance or the Glucose tolerance areas under the curve (*Lai et al J Clin Biochem. Nut, 2012*)



# Unsaponifiable Fraction of RBO

- About 3 to 5%
- $\gamma$ -Oryzanol – 2%
- Tocopherols and Tocotrienols – Vitamin E
- Phytosterols

# Oryzanol in RBO

- Potent Anti Oxidant
- Hypo cholesterolemic
- Enhances conversion of cholesterol into fecal bile acids and sterols
- When given to high cholesterol diet fed animals it inhibited platelet aggregation
- *(Patel and Naik, J Sci Ind Res, 2004)*

# Oryzanol

- Ferulic Acid and Oryzanol inhibit hepatic fat accumulation in high fat- High fructose fed rats- (*Wang et al PloS One, 2015*)
- Oryzanol enhances adipocyte differentiation and enhances Glucose uptake (*Jung et al Nutrients, 2015*)

# Tocotrienols

- Its effects are related to anti oxidant activity and it behaves like a signaling molecule
- Biological activities similar to Tocopherols
  - Neuro protective, Anti Cancer, Anti inflammatory and cholesterol lowering
- *(Ahsan et al; Nutr Metab(Lond), 2014)*

# Phyto sterols in RBO

- Plant Sterols Lower LDL Cholesterol
- In addition – Anti Cancer, Anti Inflammatory, Anti Atherogenic and Anti Oxidant,
- Interfere with Fat soluble Vitamin and Carotenoid absorption.
- *(Berger et al;Lipid Health Dis, 2004)*

# Dose of Phyto sterols

- LDL cholesterol Lowering effect continues to increase upto a dose of 3Gm/ day
- Average lowering effect of about 12%
- General Dietary intakes of phyto sterols is 200 – 400 mg /day
- *(Ras et al Br J Nutr, 2014)*

# Plant sterols are more effective with fat / oil

- Cholesterol lowering effect of Phyto sterols were better in a fat based matrix than a Non Fat food.
- *(AbuMweis et al , Food Nutr Res, 2008)*

# Phyto Sterols effect on Triglycerides

- Pooled Analysis of 12 randomized Clinical Trials
- In addition to Cholesterol Lowering effect they also effect a moderate decrease in TG
- *(Demonty et al, Eur J Nutr, 2013)*



# Conclusions- 1

- Rice Bran Oil is an Ideally fatty acid balanced oil
- Scientific Evidence confirms the health benefits of such a fatty acid combination

# Conclusions-2

- An additional source of n3 through food will give the best Cardio Vascular benefit.
- Non Glyceride components -supplement the health benefits as functional food ingredients



***Thank you***