HEALTHY BAKERY INNOVATION

Combining Vitamins & Natural Colors in Bakery Formulation

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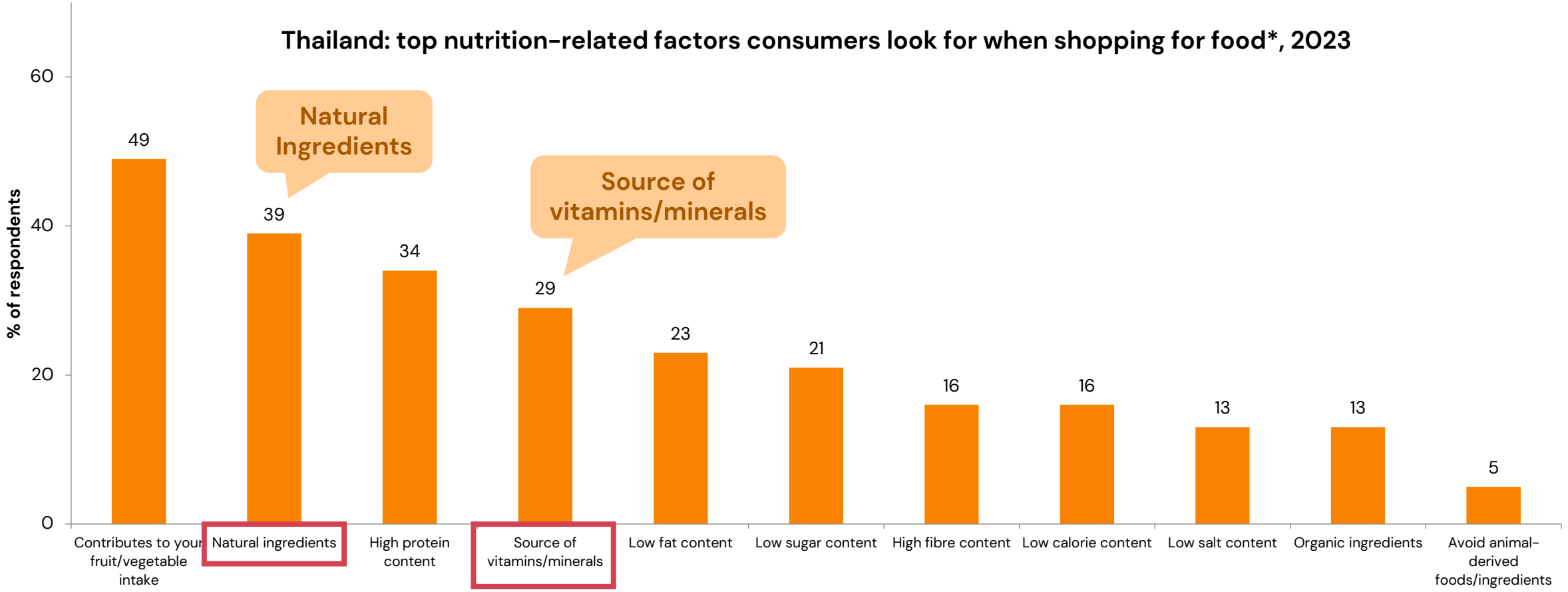
Nutrition and health benefits are strong value indicators for Thais

74% Value Health Benefits
Thais see **health-enhanced foods** as *good value for money*.

Nutrition-Focused Shoppers
Many consumers actively **check nutritional info** when purchasing



** taken from Mintel's Global Consumer*

Base: *1,000 internet users aged 18+* ***Source:*** *Kantar Profiles/Mintel, September 2023*

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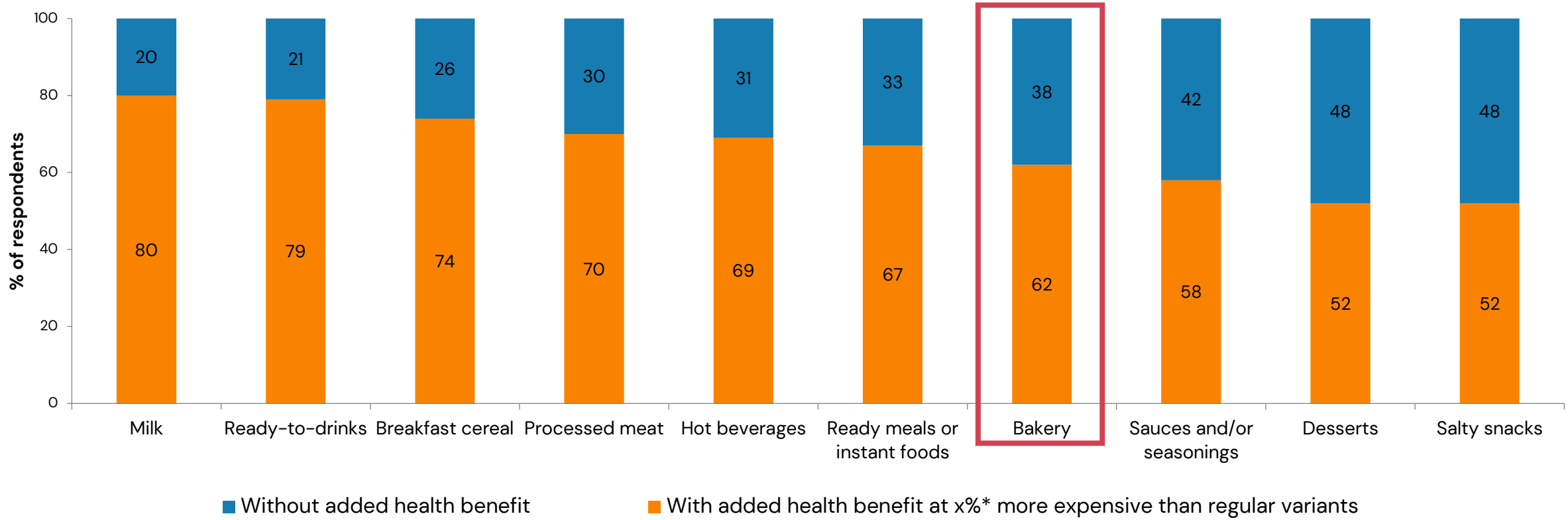
Health-consciousness drives nutrition and health functionality as strong indicators of value

- Thais prefer buying food & drink with added health benefits, even in spite of its typically higher cost.
- Taste and affordability are pivotal, but brands will increasingly need to demonstrate their health value.

Thailand: product preference, by product category, 2023



** preferred price increase for functional food & drink over regular ones varies by individual respondents*

Base: *1,070 internet users aged 18+ who are willing to pay more for food and/or drink products with added health benefits compared to those without* ***Source:*** *Dynata/Mintel, July 2023*

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Reasons for adding colors to food systems

Stability

Offset color loss due to exposure to

- Light
- Air
- Temperature extremes
- Moisture and storage conditions

Visual appearance

- Correct natural variations in color
- Enhance colors that occur naturally
- Colors always link to flavour impression

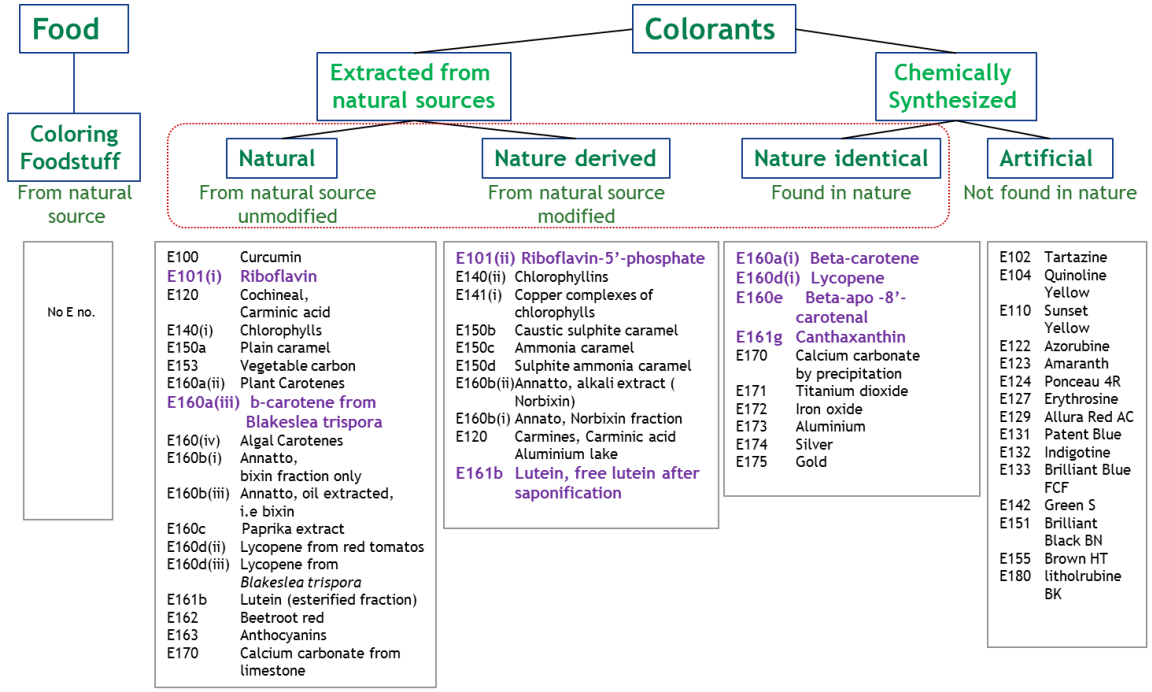
Food Color Definitions

Synthetic Colors / Artificial : These do not occur in nature and are produced by chemical synthesis.

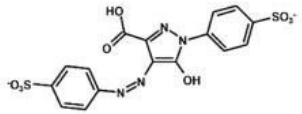
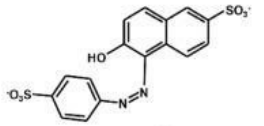
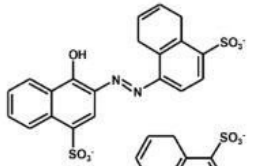
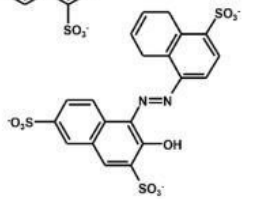
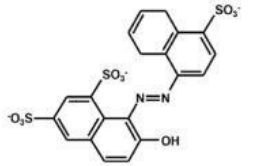
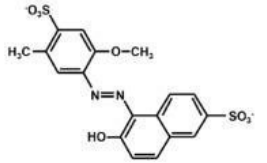
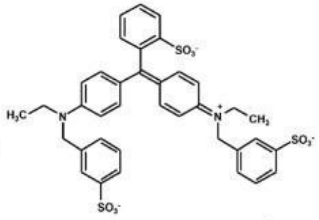
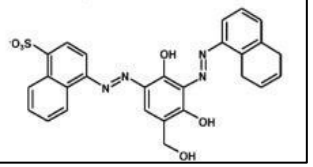
Nature Identical Colors: These colors are also manufactured by chemical synthesis, but do not require FDA certification and are considered chemically and functionally indistinguishable from the same colorant found in nature.

Natural Colors: These are extracted from agricultural/biological materials using conventional methods and do not require certification.

NATCOL Definition

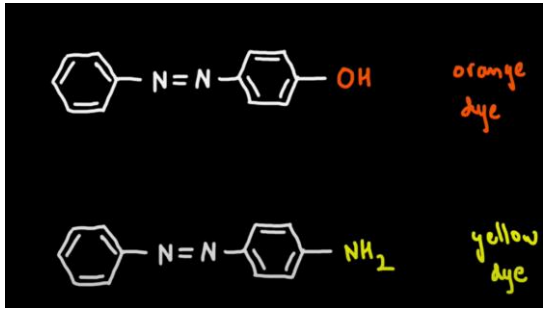


Synthetic Colors / Artificial

AZO DYE	ENS	COLOR	FOOD PRODUCT	ADI	MOLECULAR STRUCTURE
Tartrazine (Yellow 5[A]; cl 19140[B]) $C_{16}H_9N_4Na_3O_9S_2$	E102			7.5 mg/kg	
Sunset Yellow (Yellow 6[A]; cl 15985[B]) $C_{16}H_{10}N_2Na_2O_7S_2$	E110			4 mg/kg	
Carmoisine (Acid Red 14[A]; cl 14720[B]) $C_{20}H_{12}N_2Na_2O_7S_2$	E122			4 mg/kg	
Amaranth (Acid Red 27[A]; cl 16185[B]) $C_{20}H_{11}N_2Na_3O_{10}S_3$	E123			0-0.8 mg/kg	
Ponceau 4R (Acid Red 18[A]; cl 16255[B]) $C_{20}H_{11}N_2Na_3O_{10}S_3$	E124			0.7 mg/kg	
Allura Red (FD&C Red 40[A]; cl 16035[B]) $C_{18}H_{14}N_2Na_2O_8S_2$	E124			7 mg/kg	
Brilliant blue (FD&C Red 40[A]; cl 16035[B]) $C_{37}H_{34}N_2Na_2O_9S_3$	E133			6 mg/kg	
Brown HT (Food Brown 3[A]; cl 20285[B]) $C_{27}H_{18}N_4Na_2O_9S_2$	E155			1.5 mg/kg	

Azo dyes

A collective term used to describe a family of synthetic dyes containing a pair of nitrogen atoms bonded to each other (N=N) is an azo group.



Studies have indicated a potential link between these **Azo dyes** and increased **hyperactivity and attention problems in children**, including those with and without ADHD.

2007
Southampton study

Nov. 2009
EFSA reduced ADI

Jul. 2008
EU parliament Voted in favor of warning labels

20th Jul. 2010
EU Implementation Mandatory warning labels

2011
Marrocco Mandatory warning labels

2015
Saudi Arabia Mandatory warning labels

Oct. 2023
Law in CA Ban Red No. 3

Oct. 2024
Law in CA Ban azo dyes in school

Jan. 2025
US revoked authorization Red No.3.

Apr. 2025
FDA Press Conference

Jan. 2025 till present .....
US 43 Bills and 5 Laws to ban azo dyes

"May have an adverse effect on activity and attention in children"

ADI Acceptable Daily Intake

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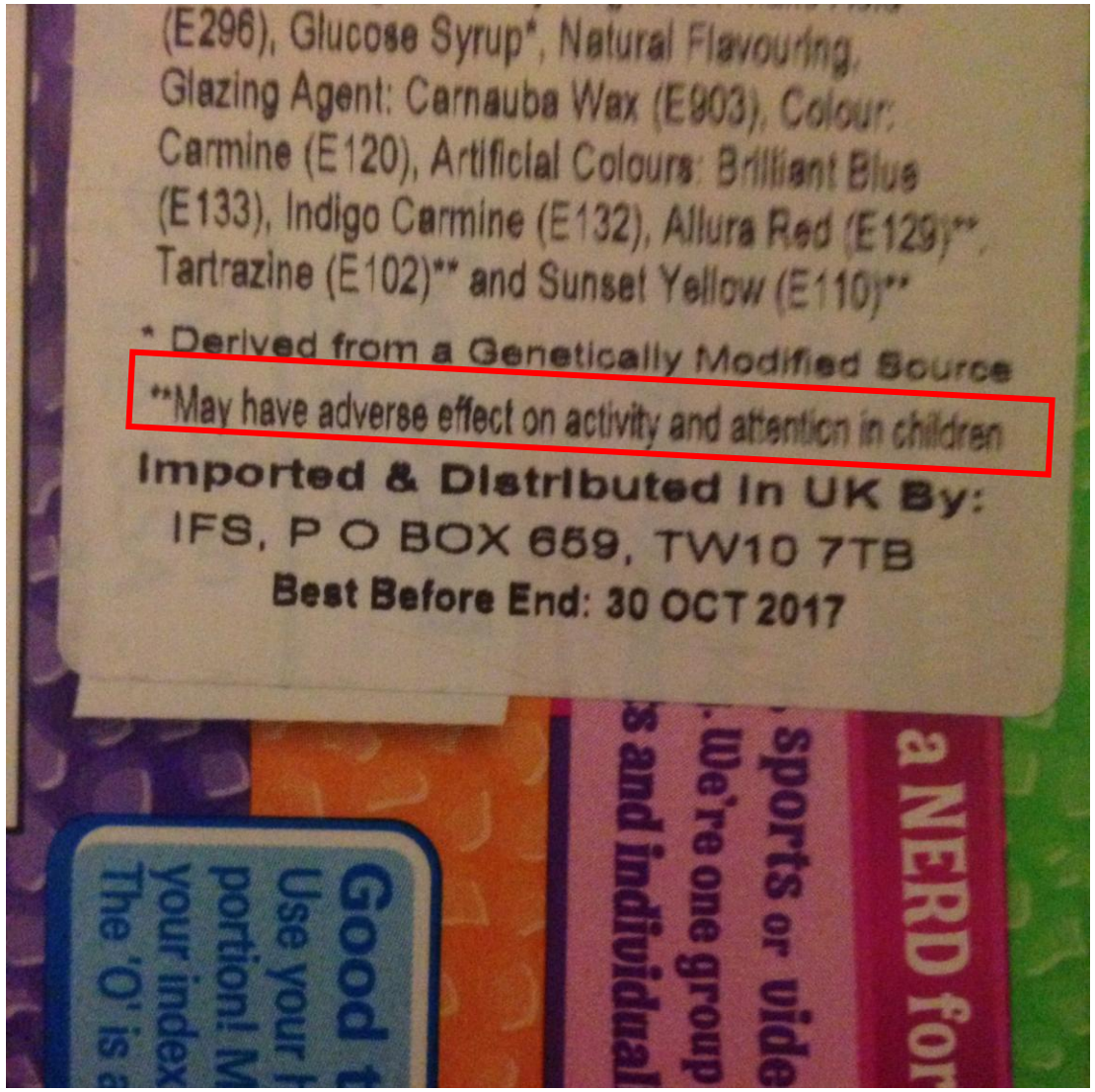
2010 EU: Implementation Mandatory warning labels



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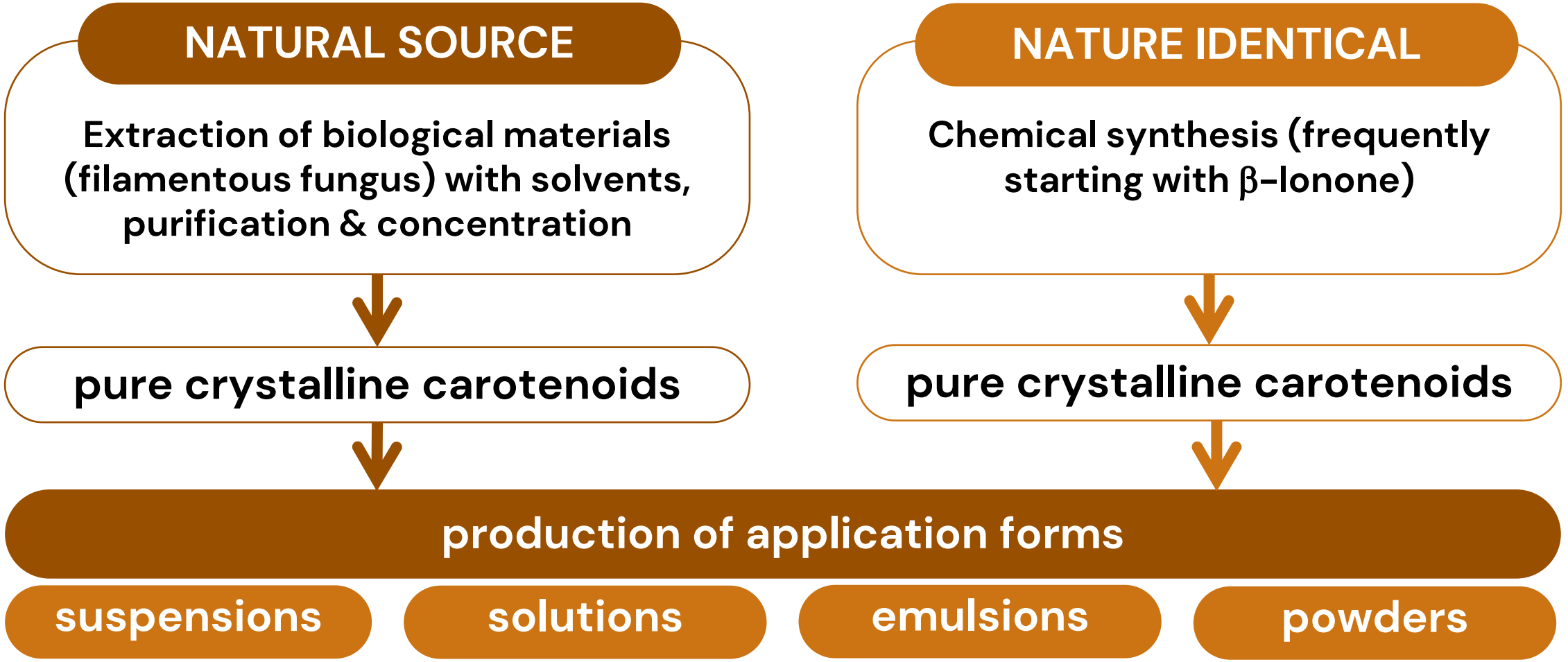
Colorations produced by dsm-firmenich

Carotenoid	Color	Function	Source & ins number
Beta-Carotene (Carocare®)	Yellow - Orange	Color Provitamin A	Natural source (Fermentation) – INS 160a (iii) Nature identical – INS 160a (i)
Riboflavin	Yellow	Color Vitamin B2	Natural Identical – INS 101 (i)
Apocarotenal	Orange	Color	Nature identical – INS 160e
Lutein (FloraGLO®)	Yellow	Color Eye health; skin health	Natural source (marigold flower) – INS 161b (i)
Lycopene	Red	Color Skin health	Nature identical – INS 160d (i)

Where do dsm-firmenich's carotenoids come from?



How to use B-Carotene in application ?

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Buttercream

Natural Colors

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Thai Tea Eclair

Natural Colors

Natural Orange Color	
Yellow	**FloraGLO®** Lutein
Red	Beetroot concentrate

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ประกาศกระทรวงสาธารณสุข

(ฉบับที่ ๔๖๘) พ.ศ. ๒๕๖๘

ออกตามความในพระราชบัญญัติอาหาร พ.ศ. ๒๕๒๒

เรื่อง กำหนดหลักเกณฑ์ เงื่อนไข วิธีการใช้ และอัตราส่วนของวัตถุเจือปนอาหาร (ฉบับที่ ๔)

CAROTENES, BETA- (กลุ่มบีตา-แคโรทีน)

INS: 160a(i)	beta-Carotenes, synthetic (บีตา-แคโรทีนสังเคราะห์) ชื่ออื่น: CI Food Orange 5; CI (1975) No. 40800	หน้าที่: สี
INS: 160a(iii)	beta-Carotenes, Blakeslea trispora (บีตา-แคโรทีนจากราบลาเคสเลีย ไทรสปอรา) ชื่ออื่น: CI Food Orange 5	หน้าที่: สี

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CAROTENES, BETA- (กลุ่มบีตา-แคโรทีน)

รหัสของหมวดอาหาร	หมวดอาหาร	ปริมาณสูงสุดที่อนุญาต (มก./กก.)	เงื่อนไข	ปีที่รับค่ากำหนด
07.1.2	แครกเกอร์ ไมรวมแครกเกอร์รสหวาน	200	341,344	2568
07.1.3	ขนมอบที่ไม่ปรุงแต่งรสชาติ ชนิดอื่นๆ	60	341,344	2568
07.1.4	ผลิตภัณฑ์ที่มีขนมปังเป็นส่วนประกอบ	30	116,341,344	2568

RIBOFLAVINS (กลุ่มไรโบเฟลวิน)

INS: 101(i)	Riboflavin, synthetic (ไรโบเฟลวินสังเคราะห์) ชื่ออื่น: Vitamin B2; Lactoflavin	หน้าที่: สี
INS: 101(ii)	Riboflavin 5'-phosphate sodium (ไรโบเฟลวิน 5'-ฟอสเฟตโซเดียม) ชื่ออื่น: Riboflavin 5'-phosphate ester monosodium salt; Vitamin B2 phosphate ester monosodium salt	หน้าที่: สี

บัญชีหมายเลข ๑ แนบท้ายประกาศฯ 569

RIBOFLAVINS (กลุ่มไรโบเฟลวิน)

รหัสของหมวดอาหาร	หมวดอาหาร	ปริมาณสูงสุดที่อนุญาต (มก./กก.)	เงื่อนไข	ปีที่รับค่ากำหนด
06.8	ผลิตภัณฑ์จากถั่วเหลือง	ปริมาณที่เหมาะสม		2568
07.0	ผลิตภัณฑ์ขนมอบ (ผลิตภัณฑ์เบเกอรี่)	ปริมาณที่เหมาะสม		2568

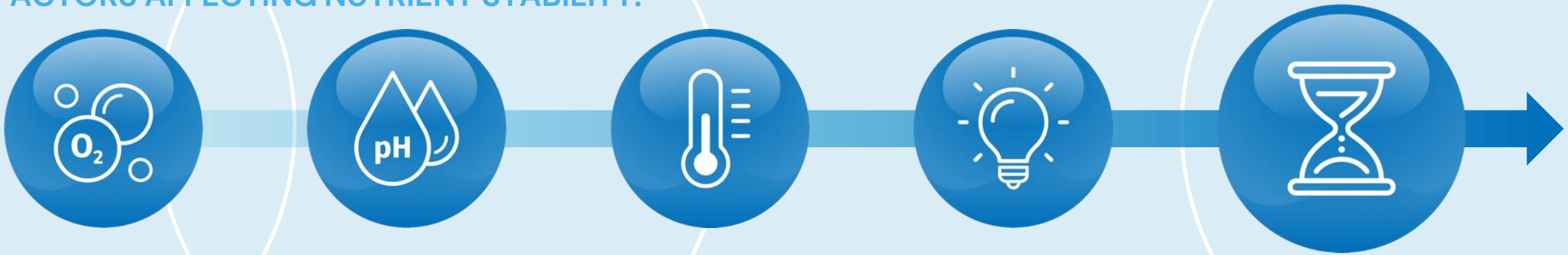
NUTRIENT STABILITY

Vitamins are a group of chemically diverse compounds that vary substantially in their stability and is susceptible to destruction by physical and chemical agents.

Stability of Vitamins in Finish Products varies.

Vitamin Stability changes over time and nothing is absolute stable, There will always be a decrease in content over a certain period dependent on certain conditions/factors

FACTORS AFFECTING NUTRIENT STABILITY:



- Oxygen
  - Composition Interactions with other ingredients
- pH Value
  - Catalysts (Iron, Copper)
- Temperature
- Light
- Time
  - Storage Condition

NUTRIENT STABILITY

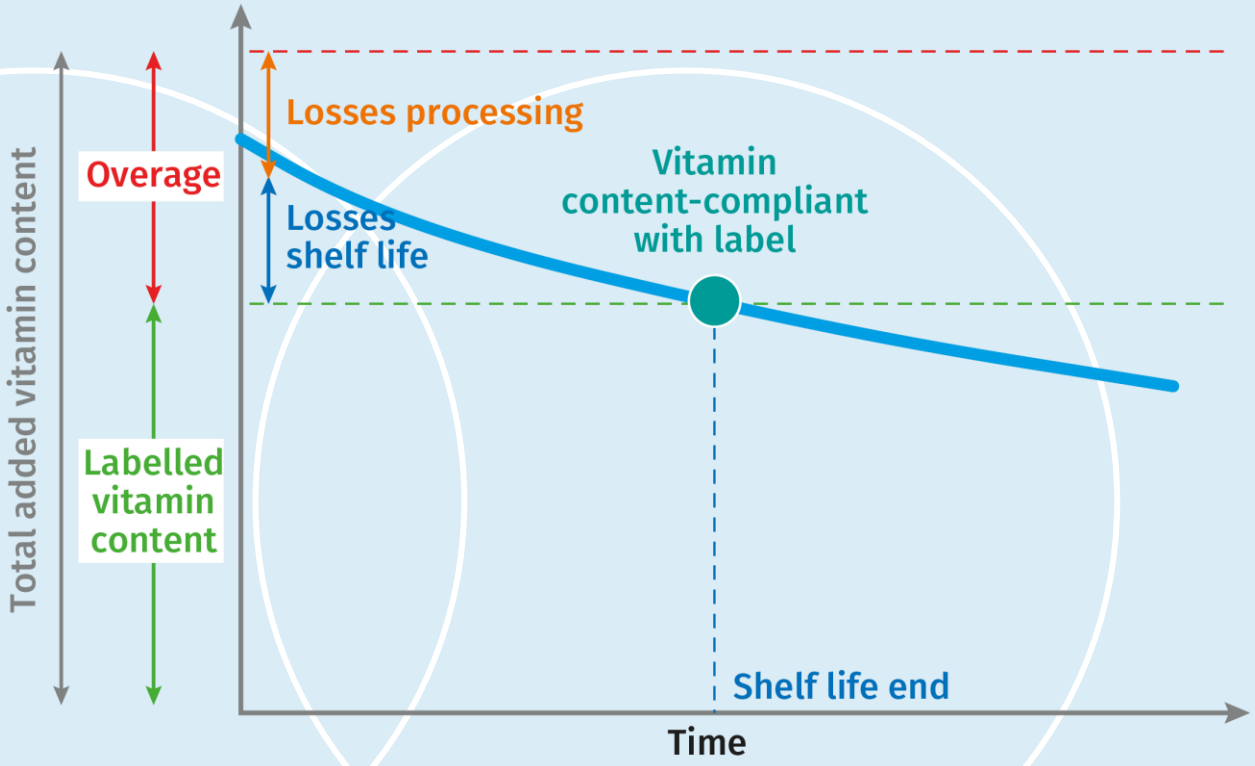
Overview of Sensitivity of Vitamins to External Factors

Vitamin	Light	Oxidizing agents	Reducing agents	Heat	Humidity	Acids	Alkalis
Vitamin A	🔴	🔴	🟢	🟠	🟢	🟠	🟢
Vitamin D	🔴	🔴	🟢	🟠	🟢	🟠	🟠
Vitamin E	🟠	🟠	🟢	🟠	🟢	🟢	🟠
Vitamin K	🔴	🟠	🟢	🟢	🟢	🟢	🔴
Vitamin C	🟢	🔴	🟢	🟠	🟠	🟠	🔴
Thiamine	🟠	🟢	🟢	🔴	🟠	🟢	🔴
Riboflavin	🔴	🟢	🟠	🟢	🟢	🟢	🔴
Niacin	🟢	🟢	🟠	🟢	🟢	🟢	🟢
Vitamin B6	🟠	🟢	🟢	🟢	🟢	🟠	🟠
Vitamin B12	🟠	🟢	🔴	🟢	🟠	🔴	🔴
Panthotenic acid	🟢	🟢	🟢	🟠	🟠	🔴	🔴
Folic acid	🟠	🔴	🔴	🟢	🟢	🟠	🟠
Biotin	🟢	🟢	🟢	🟢	🟢	🟠	🟠

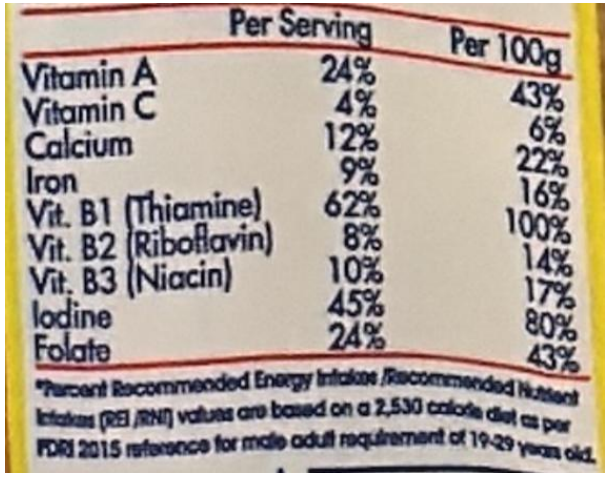
🟢 Hardly or not sensitive 🟠 Sensitive 🔴 Highly sensitive

NUTRIENT STABILITY

Overages & Compensating loses



- Both added vitamin and vitamins naturally occurring in food can exhibit significant quantitative changes during storage of foods.
- Overages are added to compensate for the losses during **process** and **storage**.
- The difference between formulated and declared levels of vitamin on the label is known as “overages”.
- Overages will vary according to inherent stability of the vitamin, process condition of food, anticipated shelf life of the product etc



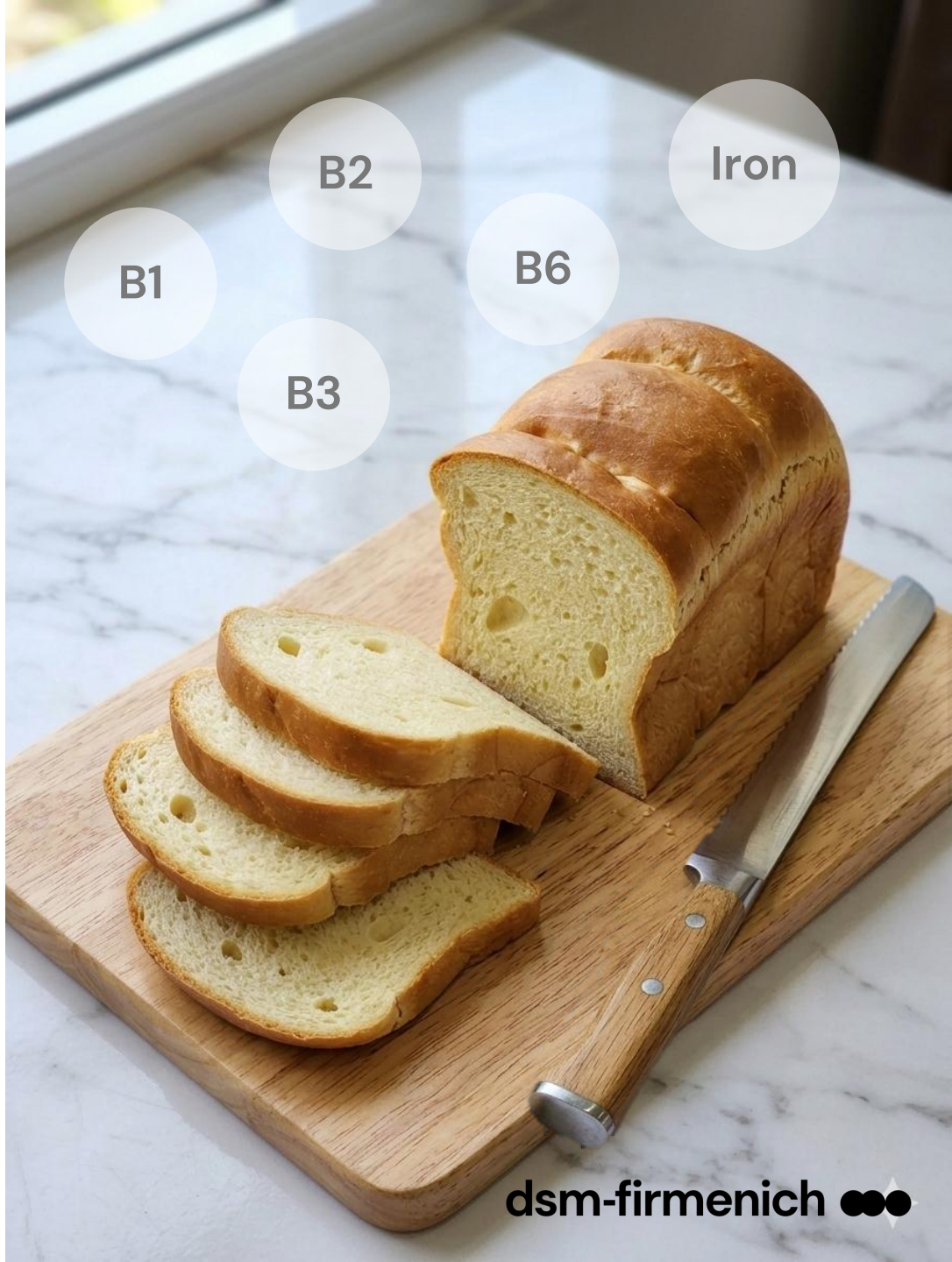
	Per Serving	Per 100g
Vitamin A	24%	43%
Vitamin C	4%	6%
Calcium	12%	22%
Iron	9%	16%
Vit. B1 (Thiamine)	62%	100%
Vit. B2 (Riboflavin)	8%	14%
Vit. B3 (Niacin)	10%	17%
Iodine	45%	80%
Folate	24%	43%

*Percent Recommended Energy Intakes /Recommended Nutrient Intakes (REI /RNI) values are based on a 2,530 calorie diet as per FDRI 2015 reference for male adult requirement of 19-29 years old.

Soft loaf bread with fortification

Vitamin B1, B2, B3, B6, Iron

Vitamin & Mineral Fortification	
B1	Normal energy yielding metabolism from carbohydrate Normal function of muscle and nervous system Normal function of the heart
B2	Normal energy yielding metabolism from carbohydrate, protein & fat Nervous system / mucous membranes / maintenance of normal red blood cells / skin / vision / metabolism of iron
B3	Maintenance of normal mucous membrane of GI tract & normal skin Normal energy yielding metabolism from carbohydrate, protein & fat Normal function of muscle and nervous system
B6	Normal red blood cell formation / nervous system / energy-yielding metabolism / protein and glycogen metabolism / immune system
Iron	Normal formation of red blood cells and hemoglobin Normal energy-yielding metabolism Normal oxygen transport in the body Normal function of the immune system



บัญชีหมายเลข ๑

ท้ายประกาศกระทรวงสาธารณสุข (ฉบับที่ ๔๔๗) พ.ศ. ๒๕๖๖

ออกตามความในพระราชบัญญัติอาหาร พ.ศ. ๒๕๒๒

เรื่อง การกล่าวอ้างทางสุขภาพของอาหารบนฉลาก

Annex 1

Attachment to Notification of the Ministry of Public Health (No. 447) B.E. 2566 issued in accordance with the Food Act B.E. 2522 Re: Health claims of foods on labels.

ข้อความกล่าวอ้างหน้าที่ของสารอาหาร (Nutrient function claim statements)

No.	Nutrients	Nutrient function claim statements (Thai)	Nutrient function claim statements (English)
อันดับ	**สารอาหาร**	**ข้อความกล่าวอ้างภาษาไทย**	**ข้อความกล่าวอ้างภาษาอังกฤษ**
๕	วิตามินบี 2 (Riboflavin)	๕.๑ วิตามินบี 2 มีส่วนช่วยให้ร่างกายได้รับพลังงานจากคาร์โบไฮเดรต โปรตีน และไขมันตามปกติ	5.1 Riboflavin contributes to normal-energy yielding metabolism from carbohydrate, protein and fat.
		๕.๒ วิตามินบี 2 มีส่วนช่วยในการทำงานตามปกติของระบบประสาท	5.2 Riboflavin contributes to the normal function of the nervous system.
		๕.๓ วิตามินบี 2 มีส่วนช่วยคงสภาพปกติของเยื่อบุต่าง ๆ	5.3 Riboflavin contributes to the maintenance of normal mucous membranes.
		๕.๔ วิตามินบี 2 มีส่วนช่วยคงสภาพปกติของเม็ดเลือดแดง	5.4 Riboflavin contributes to the maintenance of normal red blood cells.
		๕.๕ วิตามินบี 2 มีส่วนช่วยคงสภาพปกติของผิวหนัง	5.5 Riboflavin contributes to the maintenance of normal skin.
		๕.๖ วิตามินบี 2 มีส่วนช่วยคงสภาพปกติของการมองเห็น	5.6 Riboflavin contributes to the maintenance of normal vision.
		๕.๗ วิตามินบี 2 มีส่วนช่วยในเมตาบอลิซึมปกติของเหล็ก	5.7 Riboflavin contributes to the normal metabolism of iron.

Omega-3 Butter Cookies

High Vitamin D3 & Calcium

Nutrition per serving (30 g or 2 cookies)	
Omega-3 (25 mg)	**MEG-3™** fish oil
Vitamin D3 (45 mcg)	**Quali®-D** Vitamin D3
Calcium (100 mg)	

MEG-3™ trust the source

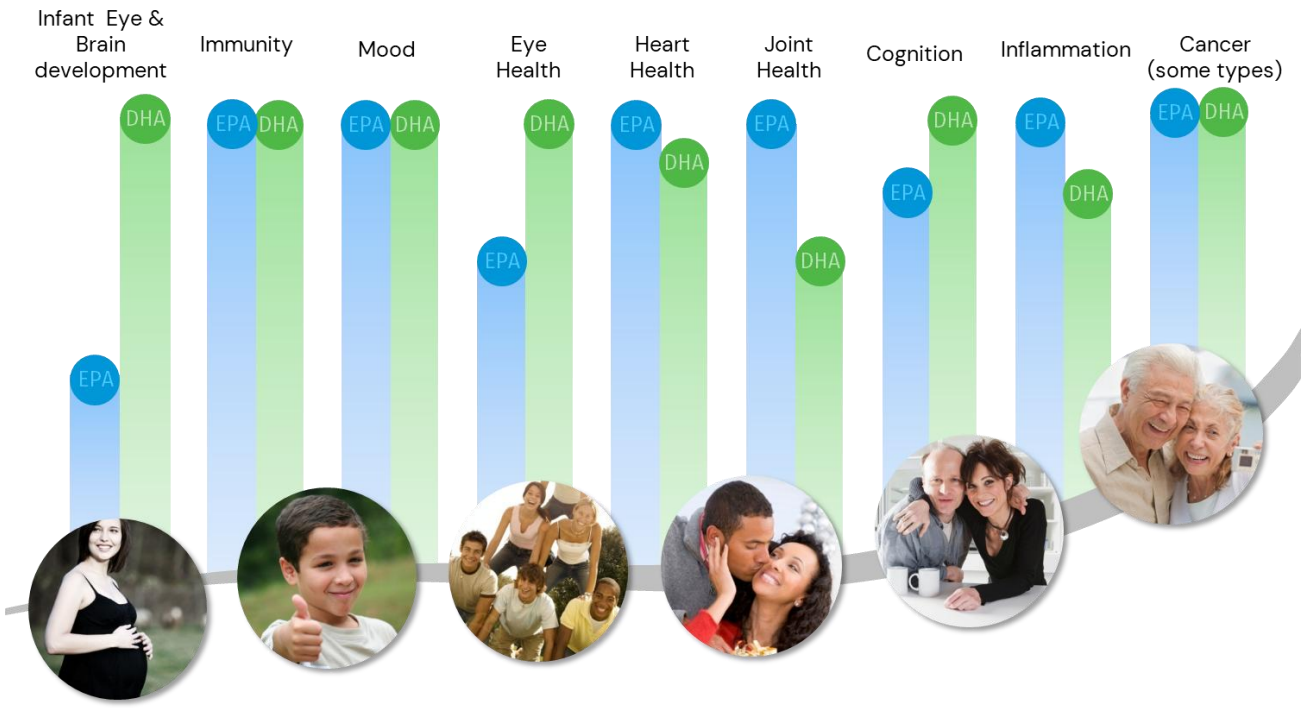
Quali®-D

MEG-3™ trust the source

life's® OMEGA

life's DHA™

Essential fatty acids (Omega-3 & Omega-6): Lifelong Benefits



- dsm-firmenich holds the most complete and confidence-inspiring portfolio of nutritional lipids forms on the market, and has an unmatched legacy of trust, innovation, service and support.
- dsm-firmenich's extensive product portfolio includes **life'sDHA – vegetarian DHA**, direct from algal sources, **life'sOMEGA EPA and DHA**, the unique and innovative vegetarian equivalent to fish oil, and **MEG-3**, the most trusted source of EPA and DHA from **fish oil**.
- Ideal for beverages, supplement and infant nutrition applications, our omega-3 solutions help our customers market products that support brain, eye and cardiovascular health across different life stages to consumers around the globe.

dsm-firmenich

Please come to visit our booth

ASIA FOOD INGREDIENTS

dsm-firmenich

We bring progress to life

dsm-firmenich