FEATURE ARTICLE

Behind the Label

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Food labels, even with hundreds of regulated stipulations, can be misleading. On the occasion of the World Food Day on October 16th and also 200 years of official detection of food adulteration, here's an article that prods you to read behind the labels.

ARE you nuts? A chicken, broccoli or simply a vegetable perhaps? After all, you really are what you eat. Sixty per cent of you is plain water. Then comes protein – 19%, concentrated in your muscles. Fats of your adipose tissue, hidden under your skin – that's 17% of you. Next the sweet stuff – carbohydrates, 3% – as glycogen in liver and glucose in the blood. About a kilogram of minerals – mostly calcium and potassium, some iron, among few others.

Not finished yet. Leave out the vitamins and you are a dead person – they are essential to your survival, yet you cannot make them on your own. On top of that, you are never the same person that you were last year – quite literally. You shed about two and a half kilogram of skin every year. Every four or six weeks, the outer layer of your skin is completely renewed – all the dust floating around in your house, most of it used to be you.

Your gut lining gets replaced every two days, the chemicals making up the brain cells get replaced about once a year. Where do you think the raw-material for this daily upgradation comes from? You guessed it right – it comes off your spoons, glasses, bowls and plates – food. Makes sense to look behind the labels of items you purchase off the supermarket shelves.

The practice goes long back and you may have chemist Frederick Accum and medic Arthur Hill Hassall, among others, to thank for introducing quality control of the food and drinks industry today. Until 1875, you could have been served alum and chalk to whiten your bread, mashed potatoes, plaster of Paris, pipe clay and sawdust to increase the weight of your loaf, rye flour and powdered beans in place of wheat. Think you would have tasted the sour taste of stale flour?

The food adulteration business would have been one step ahead – they would have added ammonium carbonate to disguise the tell-tale signs. In fact, having been served loads of such adulterants, by the beginning of the 19th century, people had started preferring their tastes over the original ones! It took the chemical analyst, consultant and teacher of chemistry, Frederick Accum, to raise the alarm.

Mineral or natural, 200 years ago, before the 1820s, there were no reliable tests for identifying food impurities and hence the rampant business of malice. But Accum developed methods to analyse and identify commonly mixed adulterants in food – much like you would use to identify unknown samples in the laboratory today.

In his 1820 release, '*A Treatise on Adulterations of Food and Culinary Poisons*' Accum exposed the nature, extent and dangers of food adulteration. The cover used the dramatic imagery of a spider's web surrounded by intertwined snakes. A spider lurks in mid-web over its prey, while a skull crowns the collection – imagery repeated again on the title page,

Table 1: Some adulterants identified by Accum (1820)

Food	Adulterant
Red cheese	Coloured with red lead (Pb3O4), and vermilion (mercury sulphide, HgS)
Cayenne pepper	Coloured with red lead
Pickles	Coloured green by copper salts
Vinegar	'Sharpened' with sulphuric acid; often contained tin and lead dissolved when boiled in pewter vessels
Confectionery	White comfits often included Cornish clay
	Red sweets were coloured with vermilion and red lead
	Green sweets often contained copper salts (eg verdigris: basic copper acetate) and Scheele's or emerald green (copper arsenite)
Olive oil	Often contained lead from the presses

Table 2: Analysis of common adulterants

Observation	Presence indicated
Black precipitate with hydrogen sulphide	Lead and copper salts
Deep blue colour with ammonium hydroxide solution	Copper
White precipitate upon reaction with barium chloride solution	Sulphates
Blue colour in dilute iodine solution in aqueous potassium iodide	Starch, used to thicken cream
Deep blue precipitate with lead acetate	Juice of bilberries or elderberries, used to adulterate red wine

captioned 'There is death in the pot', quoted from the Old Testament (II Kings chap 4, verse 40).

Accum was determined: "The man who robs a fellow subject of a few shillings on the highway is sentenced to death," he wrote in the Preface, but "he who distributes a slow poison to the whole community escapes unpunished". With the first edition being sold out within a month in the UK, a US edition was published the same year with a German translation in 1822.

Arthur Hill Hassall, a London-based physician first observed samples under the microscope – thus quantifying the adulterant and later analyzing them with chemical tests as necessary. Ignored as analytical tools before, microscopes now were the probes of choice, helping identify foreign vegetable matter, living or dead insects, minute traces of adulterants, and crystals of foreign organic matter for which no chemical tests were available. Hassall's investigations showed that adulteration was the rule, rather than the exception and eventually led up to the governmental control of adulteration and appointment of public analysts ensuring labelling standards.

Today, we depend on high-performance liquid chromatography, solid-phase microextraction gas chromatography, mass spectrometry, time of flight mass spectrometry, Raman spectroscopy near-infrared spectroscopy, fluorescence, nuclear magnetic resonance, and inductively coupled plasma optical emission spectroscopy to detect the food adulterants present in common food items. To speed up matters we even resort to electronic sensors, a combination of voltammetric e-tongue and e-nose based on metal oxide semiconductor sensors and pattern recognition techniques to detect adulteration. Manufacturers have to comply with international food labelling standards such as the Codex Alimentarius Commission, which empower the consumer to make healthy food choices.

Treating food labels as effective instruments against the prevalence of diet-related non-communicable diseases, the Codex standards stipulate Nutrient Declaration, Nutrient Reference Values, Quantitative Declaration on Ingredients (QUID), Nutrition Claims and Health Claims on food labels.

Front cover and title page of Frederick Accum's '*A Treatise on Adulterations of Food and Culinary Poisons*', 1820

As we continue to move away from traditional face-to-face food producer and buyer relationships, food labels help to convey the necessary information about the product's identity and contents, and on how to handle, prepare and consume it safely.

But labels, even with hundreds of regulated stipulations, can be misleading. An ingredient list on a food product breaks down the food into the macronutrients in terms of energy and the micronutrients in terms of quantity. Processing operations and preservation methods require additional aids, that add up to the ingredient list. Overall, it can leave the consumer frazzled, ultimately deciding to ditch the 'processed food' all together.

Have a go at the following 'mystery' label. See if you can infer the exact item that carries this label from its nutrient information. Which aisle do you expect it to be sitting at in the super-market? Do you think it is a vegetarian or non-vegetarian product? Would you have preferred it over a product that lists maybe five ingredients only in its list?

Table 3: Other adulterants found by Hassall (1851-54)

Product	Adulterants for bulk and weight	Adulterants for colour, taste and smell
Custard powders	Wheat, potato and rice flour	Lead chromate, turmeric to enhance the yellow colour
Coffee	Chicory, roasted wheat, rye and potato flour, roasted beans, acorns etc	Burnt sugar (blackjack) as a darkener
Tea	Used tea leaves, dried leaves of other plants, starch, sand china clay, French chalk	Plumbago, gum, indigo, Prussian blue for black tea, turmeric, Chinese yellow, copper salts for green tea
Cocoa and chocolate	Arrowroot, wheat, Indian corn, sago, potato, tapioca flour, chicory	Venetian red, red ochre, iron compounds
Cayenne pepper	Ground rice, mustard seed husks, sawdust, salt	Red lead, vermilion, Venetian red, turmeric
Pickles		Copper salts for greening
Gin	Water	Cayenne, cassia, cinnamon, sugar, alum, salt of tartar (potassium tartrate)
Porter & stout	Water	Brown sugar, Cocculus indicus, copperas, salt, capsicum, ginger, wormwood, coriander and caraway seeds, liquorice, honey, Nux vomica, cream of tartar, hartshorn shavings,

Table 4: Sugar with its 61 Aliases

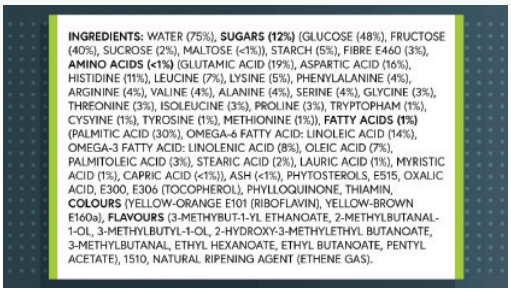
Agave nectar Barbados sugar Barley malt Barley malt syrup Beet sugar Brown sugar Buttered syrup Cane juice Cane juice crystals Cane sugar Caramel Carob syrup Castor sugar	Coconut palm sugar Coconut sugar Confectioner's sugar Corn sweetener Corn syrup Corn syrup solids Date sugar Dehydrated cane juice Demerara sugar Dextrin Dextrose	Evaporated cane juice Free-flowing brown sugars Fructose Fruit juice Fruit juice concentrate Glucose Glucose solids Golden sugar Golden syrup Grape sugar	HFCS (High-Fructose Corn Syrup) Honey Icing sugar Invert sugar Malt syrup Maltodextrin Maltol Maltose Mannose Maple syrup Molasses Muscovado Palm sugar Panocha Powdered sugar	Raw sugar Refiner's syrup Rice syrup Saccharose Sorghum Syrup Sucrose Sugar (granulated) Sweet Sorghum Syrup Treacle Turbinado sugar Yellow sugar

Table 5: Looking out for Allergens on Food Labels

Allergen	Terms to look out for		Foods to look out for	
Egg	Albumin, Binder, Coagulant, Emulsifer, Globulin/ovaglobulin, Lecithin, Livetin	Lysozyme, Ovalbumin, Ovomucin Ovomucoid, Ovovitellin, Vitellin, Simplesse	Baked goods and packaged mixes, Creamy fillings and sauces Breakfast cereals, Malted drinks and mixes, Pancakes and waffles, Marzipan, Custard	Marshmallows, Processed meat products, Pastas/egg noodles, Salad, dressings/mayonnaise, Soups, Meringue, Pudding
Milk	Caramel colour or flavoring, High protein flavor, Lactalbumin/lactalbumin phosphate, Lactoglobulin	Lactose, Natural flavouring, Solids, Simplesse	Battered foods, Baked goods and mixes, Breakfast cereals, Chocolate, Cream sauces, soups and mixes, Gravies and mixes, Ghee	Custard, puddings, sherbet, Imitation sour cream, Instant mashed potatoes, Margarine Sausages, Sweets/candies
Wheat	Flour: bleached, unbleached, white, whole wheat, all-purpose, enriched, graham, durum, high gluten, high protein, Cornstarch, Farina, Semolina, Hydrolyzed vegetable protein, Modified food starch Miso,	MSG (monosodium glutamate), Vegetable starch/gum, Gelatinized starch, Spelt, Kamut, Triticale, Malt,	Ale/beer/wine/bourbon/whiskey, Baked goods and mixes—including barley products, Battered or breaded foods, Breakfast cereals, Candy/chocolate, Processed meats, Coffee substitutes	Gravy, Ice cream and cones, Malts and flavorings, Pasta/egg noodles, Soup and soup mixes, Soy sauce, Pretzels, chips, crackers
Soy	Bulking agent, Carob, Hydrolyzed vegetable protein, (HVP)/ Hydrolyzed soy protein, Lecithin, Artificial and natural, flavoring, Bulking agent,	Miso, Monosodium glutamate (MSG), Protein, Starch, Textured vegetable protein (TVP), Vegetable broth/gum/starch	Baked goods, Some breakfast cereals, Hamburger patties, Butter substitutes/shortening, Chocolates/candy, Canned meat/fish in sauces, Canned/packaged soups, Canned tuna, Crackers, Gravies/mixes,	Asian foods, Processed meats Ice cream, Liquid/powdered meal replacers, Seasoning sauces, Seasoned salt, Snack bars, Bouillon cubes, TV dinners, Tamari
Tree	Peanut,	Groundnut	Baked goods/mixes,	Chili, Soups, Marzipan,
Nuts	Peanut butter, Groundnut	flavouring, Groundnut extract, Oriental sauce	Battered foods, Some breakfast cereals, Cereal-based products, Candy/candy bars/sweets (read label), Ice cream, Margarine/vegetable oil/vegetable fat, Some grain breads, Snack foods, Barbecue/Worcestershire sauce, Sunflower seed	Satay sauce, Milk formula, Chinese dishes/egg roll Asian dishes (e.g., Thai/ Indonesian), African dishes, Energy bars, Meat substitutes

Table 6: Allergens in seafood and shellfish

Allergen	Foods to look out for	
Fish/Seafood proteins	Worcestershire/steak sauce, Caesar salad dressing, Hot dogs/ bologna/ham, Pizza toppings, Fish sauce, Fish stock	Surimi, Caponata, Marinara sauce, Vitamin supplements (read label), Curry paste
Shellfish	Worcestershire/steak sauce, Caesar salad dressing, Hot dogs/ bologna/ham, Pizza toppings, Fish sauce, Shrimp paste, Fermented oyster sauce	Surimi, Caponata, Marinara sauce, Vitamin supplements (read label), Curry paste, Chitin or chitosan, Fermented fish stomach Fish stock,



The product listed here is a humble banana. Look closer and you will find that all the listed ingredients are naturally occurring. Water and carbohydrates make up 95% of the product – but you already knew it because you add it to your healthy smoothies and ice-creams. The fibre slows down sugar absorption – the main one being glucose here and the starch adds bulk and texture. The remaining 5% consists of protein-building amino acids, fatty acids for energy storage and cell-structure and essential fatty acids like linolenic and linoleic acids that we do not produce on our own. The rest of the ingredients are there more for the banana plant's benefit than your own. The colours from riboflavin, the aroma from the ester molecules help the plant attract insects for pollination. The ethane or ethylene gas is produced by the banana itself to ripen the fruit. Bananas are rich sources of potassium, magnesium, vitamin B6 and vitamin B12 micronutrients – but those are not revealed here.

Talking about revealing – did you know that over three-quarters of items in a typical grocery store are hiding sugar in plain sight? Added to savoury foods like sauces, breads, salad and pasta dressings or 'healthy' items like yoghurt and energy bars, sugar is known by many aliases – 61 to be precise. So, sans any 'added sugars', the diet-cola label may be made to look like the next best thing to plain water. Combining several different types of sugar in a single product makes their individual contributions look small.

Packaging apparently non-sweet foods like breakfast cereals is too easy because you will hardly be expecting to find them there. Replacing processed sugar with unrefined sugars hardly makes them healthier, but more often than not, are tagged 'diet', 'natural' and even 'healthy'. Lowering portion sizes, adding a 'low sugar variant' or lumping natural and added sugars of food items together are some other tips of the trade. Clearly, looking behind the label is your safest bet.

Aliases are particularly dangerous if you suffer food intolerances, allergies or sensitivities. Most people's bodies consider eggs, milk, wheat, soy, nuts, shellfish or seafood as offending and react adversely. What adds to the trouble is that they can easily get lost in the list of ingredients, particularly more if you are looking specifically for them. Looking for the aliases or avoiding foods with the highest probability of containing the items is thus the safest way out.

So, with a little practice, you might be able to read behind the ingredient list. But you still need to interpret it. Your body is a living record of not only all the food you eat but also all the exercises you do. You see, all our bodies have evolved to absorb and store excess fat and sugar – perhaps because they used to be scarce and yet essential for energy generation. We had to be capable of extracting and storing nutrients efficiently from food.

So, pound for pound, a large cabbage contains as much energy as a few chips – but given the choice, we tend to be drawn to the fatty, sugary, energy-rich foods and that leaves its mark on our bodies. Look behind a chips packet and the label specifies 544 kcal (2276.1 kjoules) per 100 grams of the product. Your body combines oxygen with the chips to release that much amount of energy. Is that too much?

Sitting idle, you keep spending energy on running your digestive system, breathing, keeping your brain active and keeping yourself warm. You spend as much energy as used in lighting a 60W light bulb – 60 joules per second. So, while sitting down, it would take you more than 10 hours to burn off the energy you get from a large packet of chips. Exercising – light, moderate or strenuous – helps you burn off more. As a captain of the rowing team, rowing as hard as you can, you would have burned off 16 times more energy than by sitting idle. Even then, it would have taken you about 38 minutes to have expended your precious chips pack energy stock. Here lies the importance of the delicate balance between dietary intake and energy usage – interpretation of the ingredients label could play a key factor here.

Today, on average, we are 10 centimetres taller than we would have been a century ago. That's a lot. The mean height of soldiers in the Boer War, about 150 years ago was 163 centimetres. This 5 feet 4 inches tall fully grown man would be shorter than an average teenage boy today. Childhood illness, parasite, the contributing factors can be many, but they mainly attribute to better nutrition – in quality and quantity.

Food is so important, we officially celebrate it on 16 October every year as World Food Day, mainly commemorating the founding of the Food & Agriculture Organization of the United Nations in 1945. But something that is so ubiquitous in each of our lives deserves everyday attention. So, the next time you pick up products from the shelves, remember to read behind the label – it could make you 'nuts' or even prevent you from becoming a 'vegetable'!

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