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## EDUCATIONAL SERIES

Personal Care Product Ingredients: Are Natural, Chemical Free, and Organic Always Best?

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James studied sciences at the University of Cambridge and then did his secondary school teaching qualifications at Monash University in Melbourne.

As a chemistry teacher in Australia he wanted to erode the fear that many people have of 'chemicals', and demonstrate that nature evolves compounds, mechanisms and structures far more complicated and unpredictable than anything we can produce in the lab and so started a blog and outreach effort, using infographics to illustrate the chemical makeup of familiar fruits and vegetables.

The posters he made for his students as a visual introduction to his organic chemistry course have created a lot of buzz with over 700,000 views via his blog and millions more views via social media.

James has now made all his infographics available as an educational resource that can be downloaded free of charge. They come with a Attribution-NonCommercial 4.0 International Creative Commons License, which means that you can share them, print them and modify for non-commercial purposes.

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The terms "natural", "chemical free" and "organic" are used frequently to market personal care products. The purpose of this review is to provide clarity on the meanings of these terms and the implications of their application in the marketing of personal care products. The importance of applying a science-based approach to the assessment and recommendation of personal care products is also emphasised. This review is intended as an educational resource for healthcare professionals (HCPs), including nurses, midwives, pharmacists, and pharmacy assistants.

### Definitions of natural, chemical and organic

**Natural** is defined as "having had a minimum of processing or preservative treatment".<sup>1</sup> Very few ingredients and products meet these criteria. Almost all ingredients have undergone some degree of artificial processing such as extraction, purification, and modification.

**Chemicals** are defined as a "distinct compound or substance, especially one that has been artificially prepared or purified".<sup>1</sup> Every substance on Earth is either a chemical (e.g. water, sugar, salt) or a mixture of chemicals (wood, moisturiser, olive oil), which makes "chemical free" an impossible and meaningless claim.<sup>2</sup> Chemicals can be harmless, harmful, or beneficial depending on the dose.

**Organic** ingredients are defined as being sourced from plants that were cultivated without the use of synthetic chemical fertilisers or pesticides.<sup>1</sup> However, organic certification only refers to the source of an ingredient and provides no information about its physiological or toxicological effects. Organic ingredients are natural chemicals, which have the potential to be harmless, beneficial or hazardous depending on the dose. There appears to be no published data proving that organic ingredients provide any health benefit when compared with non-organic counterparts.

### The rise of chemophobia

Throughout the 1990s and 2000s, increased public anxiety about chemicals in everyday life was exacerbated in part by the marketing of healthy products as being "chemical free".<sup>3,4</sup> Labelling a product as "natural" or "chemical free" implies that chemicals – especially those of artificial origin – are unhealthy.

The term **chemophobia**, as used to describe an "irrational fear of chemicals", has appeared in literature about family medicine and the HCP-patient relationship since as early as 2003.<sup>5,6</sup> More recently, the term has been employed with increased regularity among chemists on social media in discussions regarding lifestyle and modern living.<sup>3,7</sup> These trends reflect a growing propensity for people to be wary of the presence of chemicals in the foods and products that they consume and use.

### Chemicals can be created synthetically or extracted from natural sources

Many naturally occurring chemicals are found in commonly consumed fruits such as strawberries and blueberries (**Figure 1**).<sup>8</sup> Methylparabens, for example, are synthetic preservatives found in many cosmetic products – but they are also found naturally in blueberries and other fruits. Vitamin C for nutritional supplements is synthesised industrially from glucose, but is also found naturally in many fruits. Labelling an ingredient as "natural" or "synthetic" tells us only about its origin, and does not provide any information about its function, chemical structure, or potency.

A common misconception is that natural chemicals are safer or milder than synthetic chemicals. This idea is not supported by toxicological evidence. Many chemicals found in plants are poisonous to humans in small quantities.<sup>3,7</sup> Ricin, for example, is a highly toxic chemical that occurs naturally in castor beans.<sup>9</sup> Half a milligram of ricin can kill an adult human.<sup>10</sup> In contrast, many synthetic chemicals are harmless to humans unless ingested at extremely high doses.<sup>3,7</sup> Whether a chemical is naturally occurring or man-made tells us nothing about its toxicity. Rather, it is the dose of a chemical and how it is used that determines toxicity.

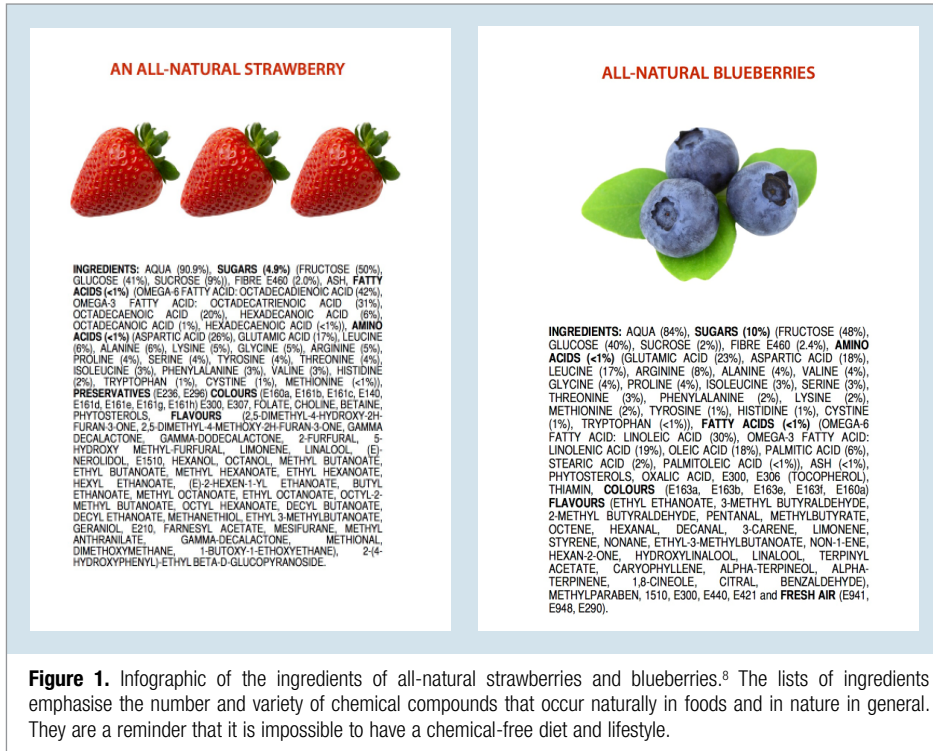
### The dose makes the poison

**Median lethal dose (LD<sub>50</sub>)** is the amount of a substance required to kill 50% of a test population. Assuming a body weight of 75kg, the LD<sub>50</sub> for water is six litres when imbibed all at once<sup>11</sup>, that of caffeine is 118 cups of coffee (or 175 shots of espresso)<sup>7</sup> and that of ethanol is 585mL (or 29 shots of vodka).<sup>12</sup> All chemicals, whether natural or synthetic, are toxic if consumed in a high enough dose.<sup>3</sup>

Furthermore, many fruits and vegetables contain natural chemicals that are toxic to humans.<sup>7</sup> However, they are present in such small quantities that they pose no threat to our health when consumed in sensible portion sizes (**Figure 2**).

Concern is sometimes expressed about the presence of formaldehyde in some vaccines.<sup>13</sup> Formaldehyde is classified as a human carcinogen.<sup>14</sup> The reality is, however, that formaldehyde occurs naturally in the environment and is produced in small amounts by most living organisms as part of normal metabolic processes. There is more formaldehyde present in the average pear than in a single vaccination shot and the quantity of formaldehyde in both is far below the dose required to cause any harm.<sup>7</sup>

Just because a chemical is harmful or carcinogenic at very high doses does not mean necessarily that it will have any ill effects at the doses encountered by people in everyday life.



**Figure 2.** Infographic of the relationship between dose and toxicity.<sup>7</sup> Many fruits and vegetables contain natural chemicals that are toxic to humans. However, these chemicals are present at doses well below the threshold at which they are harmful to humans.

## Psychology of chemophobia

Chemophobia is classed as a "non-clinical prejudice", that is, not a true medical phobia. Chemophobia is instead a learned aversion to ingredients perceived as "synthetic" in foods and personal care products. Chemophobia is based on the false assumption that "natural" ingredients are "good" and that "synthetic" ingredients are "bad". It has been suggested that chemophobia forms a part of the **behavioural immune system (BAS)** in humans.

The BAS is a suite of psychological mechanisms that first detect cues indicating the presence of pathogens in the immediate environment and then trigger emotional and cognitive responses that facilitate behavioural avoidance of the potential for pathogenic infection.<sup>15</sup> The BAS responds to an overly general set of superficial cues, which can result in aversive responses to chemicals that pose no actual threat. Chemophobia thus acts as an overly-sensitive disease-avoidance mechanism, and is most prevalent in pregnancy, the elderly, and women.<sup>16</sup>

## Psychology of preferring natural

Studies have shown that people prefer "natural" ingredients to "artificial" ingredients even when the ingredients being offered are chemically the same.<sup>17,18</sup> Two different mechanisms have been proposed to explain naturalness preference.

**Ideational reasons** are defined as beliefs justified by the perceived moral or aesthetic superiority of one choice (ingredient) over another.<sup>17</sup> Research undertaken in the early 2000s demonstrated that the majority of people who indicated a preference for natural products maintained this preference even when the healthiness and effectiveness of the natural and artificial choices were specified as equivalent. It was concluded that the motivation for preferring natural is due mainly to ideational reasons.

**Instrumental reasons** are defined as a belief in functional superiority of one product such as healthiness or effectiveness over that product's synthetic counterpart.<sup>18</sup> Recent research has shown that even though people claim ideational reasons for preferring "natural" alternatives, people do not always *believe* that the natural and synthetic alternatives are really identical. Hence, it was proposed that instrumental and ideational reasons are closely connected, and instrumental beliefs may contribute to the naturalness preference.

## Myths and facts about chemicals<sup>3</sup>

**Myth:** It is possible to lead a chemical-free life and for products to be chemical free.

**Fact:** Leading a chemical-free life is not possible because everything is made of chemicals. It therefore follows that product labelling claims such as "chemical free" are untrue. There are no alternatives to chemicals; there are only choices about which chemicals to use and in which doses.

**Myth:** Synthetic chemicals are dangerous.

**Fact:** Whether a chemical is manufactured by people or copied or extracted from nature tells us very little about its properties. "Synthetic" (or "artificial") does not necessarily mean dangerous and "natural" does not necessarily mean safe. The physiological effects of chemicals are dose-dependent: below a certain dose, a particular chemical may be harmless or beneficial, while at a higher dose, it may be toxic.

**Myth:** Synthetic chemicals cause many cancers and other diseases.

**Fact:** Claims about chemicals being linked to diseases simply tells us that a chemical was present when an event occurred rather than demonstrating that the chemical causes the effect. Caution is required when interpreting anecdotal reports of apparent correlations.

**Myth:** Exposure to a cocktail of chemicals is a ticking time-bomb.

**Fact:** Neither the presence of chemicals nor the bioaccumulation of chemicals necessarily means that harm is being done. Humans have evolved while being exposed to many different substances because nature itself is a cocktail of chemicals. The human body is accustomed to dealing with a variety of substances and is able to process and excrete substances that are potentially harmful.



### The growth of natural products

In 2014, Australians spent AU\$3.5 billion dollars on complementary medicines and natural personal care products and are projected to spend AU\$4.6 billion in 2017–18.<sup>19</sup> Collectively, Australians and New Zealanders spent AU\$14.7 million on natural and organic personal care products for babies (including moisturisers and cleansers) in 2015 compared with AU\$9 million in 2013, an increase of 63% over the past 3 years.<sup>20</sup> Natural and organic products represented 24% of overall spend on baby personal care products in 2015. This compares with 16% in 2013, which represents an increase of 50% of over three years.

These metrics indicate that the use of so-called natural or organic personal care products is substantial and is growing.

### Some natural ingredients are irritants, too

Topical personal care products based on plant-derived ingredients have gained popularity as alternatives to synthetic chemical-based products in recent years.<sup>21-23</sup> This is mainly due to the misconception that natural ingredients are safer and healthier than synthetic alternatives.

### Risk of adverse reactions

Most plant extracts are complex mixtures of compounds belonging to various chemical classes, e.g. alkaloids, phenolics, and terpenes.<sup>24,25</sup> Some of these compounds could be pharmacologically-active, which increases the risk of adverse effects.<sup>25</sup>

In particular, plant extracts have been reported in the medical literature to cause many adverse cutaneous effects including allergic contact dermatitis, urticaria, and Stevens-Johnson syndrome.<sup>26-29</sup> Natural ingredients should therefore not be excluded from consideration as potential irritants. Plant extracts of lavender, rosemary, and tea tree, for example, have all been shown to cause allergic contact dermatitis.<sup>30-34</sup>

When a HCP recommends a personal care product or prescribes a medication to treat a condition or illness, the risk of predictable adverse reactions has been weighed against the expected benefits achieved by using the product or medication.<sup>21</sup> Typically, a dosage and administration regimen is used based on the available evidence in order to maximise the benefits while minimising any adverse effects.

When consumers or patients self-treat with natural products there is evidence that they often do so without inhibition,<sup>21</sup> and often in combination with prescription medications,<sup>35</sup> which increases the potential for adverse reactions.<sup>21,35,36</sup>

### Risk of interactions

Concomitant use of natural products and prescription medications also increases the risk of adverse drug reactions that result from interactions between active compounds present in natural products and conventional drugs.<sup>25,36</sup>

Interactions between compounds present in natural products and prescription drugs may increase or decrease the pharmacological or toxicological effects via the pharmacokinetic herb-drug interactions caused by one compound interfering with the elimination, metabolism, or absorption of another compound (Figure 3).<sup>25</sup>

Pharmacodynamic herb-drug interactions are also possible.<sup>25</sup> They are caused by two different compounds working in the same or opposite directions, ultimately affecting the dose response and any mechanisms of therapeutic or toxic effects (Figure 3).

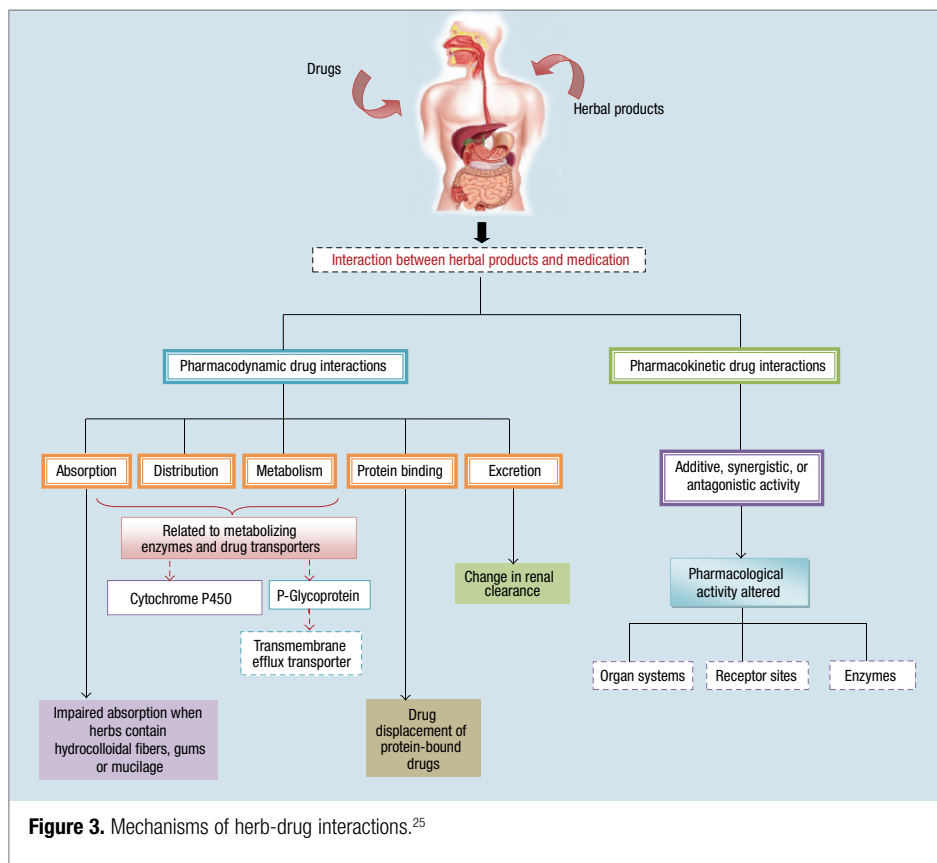


Figure 3. Mechanisms of herb-drug interactions.<sup>25</sup>

### Quality issues

The production and distribution of the plant extracts used in natural products is not uniformly standardised and regulated across countries.<sup>23</sup> Consequently, robust research into their mechanism of action, safety, physiologic stability, and optimal dosing is less than extensive.

Furthermore, there currently exists no standalone systematic pharmacovigilance for natural products and no comprehensive list of potential or predictable reactions with natural products.<sup>21,22</sup> In part, this is due to the fact that, unlike pharmaceuticals, which typically contain one well-defined and tested pharmacologically-active drug, natural products can contain many pharmacologically-active compounds.<sup>25,37,38</sup>

The composition of natural or herbal medicines also varies depending on the environmental conditions in which the source plant was grown.<sup>21</sup> Factors such as altitude, temperature, rainfall, humidity, and amount of daylight may affect the relative concentrations of constituents within a natural or herbal product.

Some adverse events associated with natural or herbal products can be attributed to the poor quality of the raw materials or the finished products.<sup>37,38</sup>

Complexity and non-uniformity of the ingredients and their doses affect the quality of natural products.<sup>37,38</sup> Contamination with toxic metals, pesticides residues, microbes, and even pharmaceutical drugs can also affect the quality. One of the most common adulterants in Chinese herbal creams have been shown to be corticosteroids.<sup>27</sup>

### Importance of consultation and collaboration

Given all of these considerations, HCPs have an obligation to discuss the use of natural products with their clients or patients and encourage full disclosure of their use.<sup>21</sup> In a US national survey of individuals using complementary or alternative medications specifically for skin conditions, only 17% discussed their use of natural products with a HCP.<sup>39</sup>

For many individuals, the decision to use a natural product is centred on philosophical or cultural beliefs,<sup>40</sup> i.e. ideational reasons. These beliefs could stem from a disbelief that synthetic chemicals can be safe, and possibly from a distrust of scientists as well. Hence, rather than dismissing a therapy because it is unorthodox, HCPs might achieve better outcomes by partnering with their clients or patients to develop a jointly-agreed approach to achieve the same healthcare goal.

### Practice tips for HCPs

- Personal care product recommendations should be based on:
  - Scientific evidence and clinical expertise and knowledge.
  - Awareness of the motivational factors that drive client/patient preferences.
- Botanical or herbal extracts should be considered as a potential source of adverse skin events and interactions.
- Use of natural products should be identified and discussed with patients/clients and a treatment plan jointly agreed.
- For Neonatal Skin care resources see:
  - [ACNN 2015 Conference Symposium Highlights](#) or go to [www.researchreview.co.nz](http://www.researchreview.co.nz)
  - [AWHONN Evidence Based Clinical Practice Guideline](#) and [AWHONN QUICK CARE GUIDE](#)

### Expert commentary — Shaun Holt

In terms of health treatments, there is an ongoing increase in the popularity of “natural health” products and therapies. This rise in popularity is at least partly attributable to disillusionment with modern medicine and, in particular, pharmaceutical medicines and the “big drug companies”. Proponents of natural health tend to focus on adverse events from pharmaceutical medicines and there is no doubt that this is an issue. For example, the *New England Journal of Medicine* published a paper showing that 106,000 patients die and 2.2 million are injured by adverse reactions to pharmaceutical medicines each year, making the use of pharmaceutical medicines the third leading cause of death behind heart disease and cancer. However, it is sometimes forgotten that the products that the pharmaceutical industry make are responsible for improving, lengthening, and saving the lives of hundreds of millions of people each year, and I would argue that the benefits far exceed the harm.

Also often overlooked in the debate is the overlap between pharmaceutical medicines and natural products. One quarter of prescription medicines are taken directly from plants or are chemically modified versions of compounds that are taken directly from plants, and over half of pharmaceutical medicines are modelled on natural compounds.

Many people also falsely assume that natural health products are safe, but there are number of ways in which they can cause harm, some of which are not immediately obvious. Examples of direct harm from using natural products include cyanide poisoning from laetrile (amygdalin, a plant compound) salmonella infections from drinking raw dairy products, and disfigurement after the application of corrosive chemicals for skin cancers. Indirect harm is not as obvious and can be caused when people *delay* using conventional proven treatments when they choose to first try natural products or, more concerning, when they *substitute* effective pharmaceutical medicines for natural products, i.e. use the natural products as alternative treatments.

### Expert commentary — James Kennedy

It is impossible to be “chemical free”. Such marketing claims are pandering to – and exaggerating – people’s fear of science and scientists, and are doing so to justify price increases at the point of sale.

Companies that use the terms “chemical free”, “organic” and “natural” are exploiting a legal and psychological loophole, by which, they can make dubious, unverified claims about the efficacy of their product and sell them for a higher price. Organic coffee is one such example: the naturally-occurring caffeine in coffee beans is several orders of magnitude more dangerous than the traces of pesticide residue that might be present in non-organic coffee.

Dangerous examples include the promotion of olive oil for use on baby skin – particularly on areas affected with atopic dermatitis (eczema). As trusted authority figures, it is imperative that HCPs initiate discussions with parents about safe skin care practices.

“Natural” is a widely-misused term. “Natural” ingredients are widely assumed to be milder even though many so-called “natural” ingredients are irritants. Many natural ingredients are highly variable (depending on source location and seasonality) and have generally undergone less extensive testing than synthetic compounds. Whether an ingredient is labelled “natural” tells us nothing about its toxicity, purity, or potency.

Communication between HCPs and patients will be key to tackling chemophobia. Does the patient know that D-limonene, found in orange oil, is a potent skin irritant? Does the patient know that oleic acid, present in olive oil, damages the skin, and that baby oil – which is inert – is a much safer alternative? HCPs need to tackle the misconceptions surrounding “natural” products by initiating discussions with patients.

In the long term, we need legislation to ban the use of “natural” and “chemical free” on product labels. “No unnecessary ingredients” might be a more sensible marketing claim, and has already been adopted by some manufacturers.

### Take-home messages

- Chemophobia may be an emotional response despite lack of a real threat.
- Chemicals are everywhere and in everything.
- Natural chemicals are not necessarily safer than synthetic chemicals.
- Naturalness preference may be due ideational and/or instrumental reasons.
- The biological effect of a chemical, synthetic or natural, depends on the dose.
- It is impossible for personal care products to be chemical free.
- The presence of chemicals in a personal care product does not mean they are harmful in the amount present.
- An organically-sourced natural chemical can be harmless, beneficial, or hazardous.
- Natural personal care products are associated with adverse skin reactions and interactions.

### REFERENCES

- Oxford English Dictionary. Oxford, UK: Oxford University Press. Available from: <http://www.oxforddictionaries.com/words/the-oxford-english-dictionary>. [Date accessed: 17/02/16].
- Australian Competitor and Consumer Commission (ACCC). Cosmetic compliance and safety and the Australian Consumer Law. Adelaide, SA: Australian Competition and Consumer Commission. Available from: <http://www.accc.gov.au/speech/cosmetic-compliance-and-safety-and-the-australian-consumer-law>. [Date accessed: 16/02/16].
- Sense About Science. Making sense of chemical stories. A guide for the lifestyle sector and anybody with questions about chemical stories. 2<sup>nd</sup> Edition 2014. London, UK: Sense About Science. Available from: <http://www.senseaboutscience.org/data/files/resources/154/MakingSenseofChemicalStories2.pdf>.
- Lorch M. Manmade or natural, tasty or toxic, they're all chemicals. The Guardian. 19 May 2014 (col. Chemistry, Notes & Theories). London, UK: Guardian News and Media Limited. Available from: <http://www.theguardian.com/science/blog/2014/may/19/manmade-natural-tasty-toxic-chemicals>. [Date accessed: 13/01/16].
- Simpson WM, Jr., et al. Chemophobia, family medicine, and the doctor-patient relationship. J Agromedicine. 2003;9(1):7-16.
- Environmental Health and Toxicology. IUPAC Glossary of Terms Used in Toxicology, 2nd Edition – Terms Starting with C. Bethesda, MD: U.S. National Library of Medicine. Available from: <https://sis.nlm.nih.gov/enviro/iupacglossary/glossaryc.html>. [Date accessed: 16/02/16].
- Brunning A. Natural vs Man-Made Chemicals – Dispelling Misconceptions. Compound Interest. Cambridge, UK: Andy Brunning/Compound Interest. Available from: <http://www.compoundchem.com/2014/05/19/natural-vs-man-made-chemicals-dispelling-misconceptions/>. [Date accessed: 13/01/16].
- Kennedy J. All-natural banana and other fruits. Melbourne, VIC: James Kennedy. Available from: <https://jameskennedymonash.wordpress.com/category/infographics/all-natural-banana-and-other-fruits/>. [Date accessed: 11/01/16].
- Centers for Disease Control and Prevention. Facts about ricin. Emergency Preparedness and Response. Atlanta, GA: Centres for Disease Control and Prevention. Available from: <http://www.bt.cdc.gov/agent/ricin/facts.asp>. [Date accessed: 13/01/16].
- Universitat Autònoma de Barcelona (UAB). Toxins and Known LD<sub>50</sub> Values. Barcelona: Universitat Autònoma de Barcelona. Available from: [http://www.uab.cat/doc/DL50\\_biotoxines](http://www.uab.cat/doc/DL50_biotoxines). [Date accessed: 16/02/16].
- Brunning A. Lethal doses of water, caffeine and alcohol. Compound Interest. Cambridge, UK: Andy Brunning/Compound Interest. Available from: <http://www.compoundchem.com/2014/07/27/lethaldoses/>. [Date accessed: 11/01/16].
- Tsibulsky VL, et al. Tolerance to effects of high doses of ethanol: 1. Lethal effects in mice. Pharmacol Biochem Behav. 1993;45(2):465-72.
- Musgrave, I. ‘Toxins’ in vaccines: a potentially deadly misunderstanding. The Conversation. Melbourne, VIC: The Conversation Media Group Ltd. Available from: <http://theconversation.com/toxins-in-vaccines-a-potentially-deadly-misunderstanding-11010>. [Date accessed: 16/02/16].
- National Cancer Institute. Formaldehyde and cancer risk. Bethesda, MD: National Institutes of Health. Available from: <http://www.cancer.gov/about-cancer/causes-prevention/risk/substances/formaldehyde/formaldehyde-fact-sheet#q1>. [Date accessed: 18/01/16].
- Schaller M. The behavioural immune system (and why it matters). Curr Dir Psychol Sci. 2011;20(2):99-103.
- Oaten M, et al. Disgust as a disease-avoidance mechanism. Psychol Bull. 2009;135(2):303-21.
- Rozin P, et al. Preference for natural: instrumental and ideational/moral motivations, and the contrast between foods and medicines. Appetite. 2004;43(2):147-54.
- Li M, et al. Why Do People Like Natural? Instrumental and Ideational Bases for the Naturalness Preference. J Appl Soc Psych. 2012;42(12):2859-78.
- Complementary Medicines Australia. In good health: 2014 Complementary medicines industry survey. Mawson, ACT: Complementary Medicines Australia. Available from: <http://www.cmaustralia.org.au/resources/Documents/Reports/CMA%20Industry%20Audit%202014.pdf>.
- Johnson & Johnson Pacific. Grocery and pharmacy sales of baby toiletries for New Zealand and Australia 2015 [Data on file]. Sydney: Johnson & Johnson Pacific Pty Ltd.
- Chouakea J, et al. Herbal medicine in dermatology: does natural = safe? J Drugs Dermatol. 2012;11(6):774-6.
- Shaw D, et al. Pharmacovigilance of herbal medicine. J Ethnopharmacol. 2012;140(3):513-8.
- Krausz A, et al. The basic science of natural ingredients. J Drugs Dermatol. 2014;13(8):937-43; quiz 44-5.
- Klaschka U. Naturally toxic: natural substances used in personal care products. Environ Sci Eur. 2015;27:1.
- Corazza M, et al. Topical botanically derived products: use, skin reactions, and usefulness of patch tests. A multicentre Italian study. Contact Dermatitis. 2014;70(2):90-7.
- Corazza M, et al. Use of topical herbal remedies and cosmetics: a questionnaire-based investigation in dermatology out-patients. J Eur Acad Dermatol Venerol. 2009;23(11):1298-303.
- Ernst E. Adverse effects of herbal drugs in dermatology. Br J Dermatol. 2000;143(5):923-9.
- Koo J, et al. Traditional Chinese medicine in dermatology. Dermatol Ther. 2003;16(2):98-105.
- Herro E, et al. Mentha piperita (peppermint). Dermatitis. 2010;21(6):327-9.
- Larson D, et al. Tea tree oil. Dermatitis. 2012;23(1):48-49.
- Miroddi M, et al. Rosmarinus officinalis L. as cause of contact dermatitis. Allergol Immunopathol (Madr). 2014;42(6):616-9.
- Wu PA, et al. Lavender. Dermatitis. 2011;22(6):344-7.
- Rutherford T, et al. Allergy to tea tree oil: retrospective review of 41 cases with positive patch tests over 4.5 years. Australas J Dermatol. 2007;48(2):83-7.
- Necyk C, et al. Pharmacy study of natural health product adverse reactions (SONAR): a cross-sectional study using active surveillance in community pharmacies to detect adverse events associated with natural health products and assess causality. BMJ Open. 2014;4(3):e003431.
- Skalli S, et al. Safety monitoring of herb-drug interactions: a component of pharmacovigilance. Drug Saf. 2012;35(10):785-91.
- Neerghen-Bhujin VS. Underestimating the toxicological challenges associated with the use of herbal medicinal products in developing countries. Biomed Res Int. 2013;2013:804086.
- Sahoo N, et al. Herbal drugs: standards and regulation. Fitoterapia. 2010;81(6):462-71.
- Zhang J, et al. Quality of herbal medicines: challenges and solutions. Complement Ther Med. 2012;20(1-2):100-6.
- Ruparel P, et al. The quality of commercially available herbal products. Nat Prod Commun. 2011;6(5):733-44.
- Smith N, et al. Use of complementary and alternative medicine among adults with skin disease: results from a national survey. J Am Acad Dermatol. 2009;60(3):419-25.