

The Truth About Vitamins in Supplements

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Abstract: *Even though natural health professionals agree that humans should not try to consume petroleum derivatives or hydrogenated sugars, most seem to overlook this fact when vitamin supplementation is involved. This paper explains some of the biochemical reasons that food vitamins are superior for humans. It also explains what substances are commonly used to make vitamins in supplements. Furthermore, it explains some of the advantages of food vitamins over the non-food vitamins that are commonly available.*

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Introduction

For decades the 'natural' health industry has been touting thousands of vitamin supplements. The truth is that most vitamins in supplements are made or processed with petroleum derivatives or hydrogenated sugars [1-5]. Even though they are often called natural, most non-food vitamins are isolated substances which are crystalline in structure [1]. Vitamins naturally in food are not crystalline and never isolated. **Vitamins found in any real food are chemically and structurally different from those commonly found in 'natural vitamin' formulas.** Since they are different, naturopaths should consider non-food vitamins as vitamin analogues (imitations) and not actually vitamins.

The standards of naturopathy agreed to in 1947 included the statements, "Naturopathy does not make use of synthetic or inorganic vitamins...Naturopathy makes use of the healing properties of...natural foods, organic vitamins" [5]. Even back in the 1940s, professionals interested in natural health recognized the value of food, over non-food, vitamins. Also, it should be mentioned that naturopathic definition of organic back then was similar to the official US government definition today—why does this need to be stated? Because one pseudo-naturopath once told this researcher that a particular brand of synthetic vitamins contained "organic vitamins", because a sales representative had told him so. Sadly, that sales representative either intentionally gave out false information or gave out misleading information—misleading because by its 'scientific' definition, the term 'organic' can mean that it is a carbon containing substance, hence by that definition all petroleum derivatives (hydro-carbons) are organic. But they are not organic from the naturopathic, or even the U.S. government's, perspective.

Officially, according to mainstream science, "Vitamins are organic substances that are essential in small amounts for the health, growth, reproduction, and maintenance of one or more animal species, which must be included in the diet since they cannot be synthesized at all or in sufficient quantity in the body. Each vitamin performs a specific function; hence one cannot replace another. Vitamins originate primarily in plant tissues" [6].

Isolated non-food 'vitamins' (often called 'natural' or USP or pharmaceutical grade) are not naturally "included in the diet", do not necessarily "originate primarily in plant tissues", and cannot fully replace all natural vitamin activities. As a natural health

professional, you should be able to read and interpret, even misleading supplement labels. For those who are unsure, hopefully this article will provide sufficient information to determine if vitamin tablets are food or imitations.

What is Your Vitamin Really?

Most vitamins in supplements are petroleum extracts, coal tar derivatives, and chemically processed sugar (plus sometimes industrially processed fish oils), with other acids and industrial chemicals (such as formaldehyde) used to process them [1-5]. Synthetic vitamins were originally developed because they cost less [7]. Assuming the non-food product does not contain fish oils, most synthetic, petroleum-derived, supplements will call their products ‘vegetarian’, not because they are from plants, but because they are not from animals. Most vitamins in vitamin supplements made from food are in foods such as acerola cherries, alfalfa sprouts, carrots, corn, grapefruit, lemons, limes, nutritional yeast, oranges, rice bran, soy beans, and tangerines (some companies also use animal products).

Table 1. Composition of Food and Non-Food Vitamins [1-10]

Vitamin	Food Nutrient*	‘Natural’ Vitamin Analogue & Some Process Chemicals
Vitamin A/ Betacarotene	Carrots	Methanol, benzene, petroleum esters; acetylene; refined oils
Vitamin B-1	Nutritional yeast, rice bran	Coal tar derivatives, hydrochloric acid; acetonitrole with ammonia
Vitamin B-2	Nutritional yeast, rice bran	Synthetically produced with 2N acetic acid
Vitamin B-3	Nutritional yeast, rice bran	Coal tar derivatives, 3-cyanopyridine; ammonia and acid
Vitamin B-5	Nutritional yeast, rice bran	Condensing isobutyraldehyde with formaldehyde
Vitamin B-6	Nutritional yeast, rice bran	Petroleum ester & hydrochloric acid with formaldehyde
Vitamin B-8	Corn, rice bran	Phytin hydrolyzed with calcium hydroxide and sulfuric acid
Vitamin B-9	Alfalfa sprouts, rice bran	Processed with petroleum derivatives and acids; acetylene
Vitamin B-12	Nutritional yeast	Cobalamins reacted with cyanide
Vitamin ‘B-x’ PABA	Nutritional yeast	Coal tar oxidized with nitric acid (from ammonia)
Vitamin B Factor Choline	Nutritional yeast, rice bran	Ethylene and ammonia with HCL or tartaric acid
Vitamin C	Acerola cherries, citrus fruits	Hydrogenated sugar processed with acetone
Vitamin D	Nutritional yeast	Irradiated animal fat/cattle brains or solvently extracted
Vitamin E	Corn, soy beans, vegetable oils	Trimethylhydroquinone with isophytol; refined oils
Vitamin K	Alfalfa sprouts	Coal tar derivative; produced with p-allelic-nickel

* Note: Although some companies use liver extracts as a source for vitamins A and/or D, no company this researcher is aware of whose products are made out of 100% food use animal products for any of their multiple vitamins. Some companies also use brewer’s yeast which is inferior to nutritional yeast in many ways (including the fact that it has not had the cell wall enzymatically processed to reduce possible sensitivities).

Read The Label to See the Chemical Differences!

Although many doctors have been taught that food and non-food vitamins have the same chemical composition, this is simply untrue for most vitamins. As shown in table 2, the chemical forms of food and synthetic nutrients are normally different. Health professionals need to understand that since there is no mandated definition of the term 'natural'; just seeing that term on a label does not mean that the supplement contains only natural food substances. One of the best ways to tell whether or not a vitamin supplement contains natural vitamins as found in food is to know the chemical differences between food and non-food vitamins (sometimes called USP vitamins). Because they are not normally in the same chemical form as vitamins found in foods, non-food vitamins should be considered by naturopaths as vitamin analogues (artificial imitations), and not actually as true vitamins for humans.

Table 2. Chemical Form of Food and Non-Food Vitamins [1-10]

Chemical Vitamin Form in Food	Vitamin Analogue Chemical Form (Often Called Natural*)
Vitamin A/Betacarotene; retinyl esters; mixed carotenoids	Vitamin A acetate; vitamin A palmitate; betacarotene (isolated)
Vitamin B-1; thiamin pyrophosphate (food)	Thiamin mononitrate; thiamin hydrochloride; thiamin HCL
Vitamin B-2; riboflavin, multiple forms (food)	Riboflavin (isolated); USP vitamin B2
Vitamin B-3; niacinamide (food)	Niacin (isolated); niacinamide (isolated)
Vitamin B-5; pantothenate (food)	Pantothenic acid; calcium pantothenate; panthenol
Vitamin B-6; 5'0 (beta-D) pyridoxine	Pyridoxine hydrochloride; pyridoxine HCL
Vitamin B-9; folate	Folic acid
Vitamin B-12; methylcobalamin; deoxyadenosylcobalamin	Cyanocobalamin; hydroxycobalamin
Choline (food); phosphatidyl choline (food)	Choline chloride; choline bitartrate
Vitamin C; ascorbate (food); dehydroascorbate	Ascorbic acid; most mineral ascorbates (i.e. sodium ascorbate)
Vitamin D; mixed forms, primarily D3 (food)	Vitamin D1 (isolated); Vitamin D2 (isolated); Vitamin D3 (isolated) ; Vitamin D4; ergosterol (isolated); cholecalciferol (isolated); lumisterol
Vitamin E; RRR-alpha-tocopherol (food)	Vitamin E acetate; Mixed tocopherols; <i>all-rac</i>-alpha-tocopherol; d-l—alpha-tocopherol; d-alpha-tocopherol (isolated); dl-alpha-tocopheryl acetate; all acetate forms
Vitamin K; phylloquinone (food)	Vitamin K3; menadione; phytonadione; naphthoquinone; dihydro-vitamin K1

* Note: This list is not complete and new analogues are being developed all the time. Also the term "(isolated)" means that if the word "food" is not near the name of the substance, it is probably an isolate (normally crystalline in structure) and is not the same as the true vitamin found in food.

Read the label of any supplement to see if the product is truly 100% food. If even one USP vitamin analogue is listed, then the entire product is probably not food (normally it will be less than 5% food). Vitamin analogues are cheap (or not so cheap) imitations of vitamins found in foods.

Food Vitamins are Better than Non-Food Vitamins

Although many mainstream health professionals believe, "The body cannot tell whether a vitamin in the bloodstream came from an organically grown cantaloupe or from a chemist's laboratory" [11], this belief is quite misleading for several reasons. First it seems to assume that the process of getting the amount of the vitamin into the bloodstream is the same (which is frequently not the case [3-10]). Secondly, scientists understand that particle size is an important factor in nutrient absorption even though particle size is not detected by chemical assessment. Thirdly, scientists also understand that, "The food factors that influence the absorption of nutrients relate not only to the nature of the nutrients themselves, but also their interaction with each other and with the nonabsorbable components of food" [12]. Fourthly, "the physiochemical form of a nutrient is a major factor in bioavailability" (and food and non-food vitamins are not normally in the same form) [13]. Fifthly, most non-food vitamins are crystalline in structure [1]. Food vitamins are in the physiochemical forms which the body recognizes, generally are not crystalline in structure, contain food factors that affect bioavailability, and appear to have smaller particle sizes (see illustrations in table 3). This does not mean that non-food vitamins do not have any value (they clearly do), but it is important to understand that natural food complex vitamins have actually been shown to be better than isolated, non-food, vitamins (see table 4).

Electron microscopy indicates that isolated USP vitamins appear larger and have a crystalline appearance compared to vitamins in foods which have more of a rounded and smaller appearance.

Even before there were electron microscopes, the late Dr. Royal Lee knew that food vitamin C was superior to ascorbic acid. "Dr. Lee felt it was not honest to use the name 'vitamin C' for ascorbic acid. That term 'should be reserved for the vitamin C COMPLEX'" [14]. Why then, according to the ingredients listed in a recent catalog, would a supplement company that Dr. Lee originally founded currently include ascorbic acid, inorganic mineral salts, and/or other isolated nutrients in the majority of its products? Dr. Lee, like the late Dr. Bernard Jensen [15], was also opposed to the use of other isolated, synthetic, nutrients [14]. Dr. Lee specifically wrote, "In fact, the Food & Drug laws seem to be suspended where synthetic imitations of good foods are concerned, and actually perverted to prosecute makers and sellers of real products...The synthetic product is always a simple chemical substance, while the natural is a complex mixture of related and similar materials...Pure natural Vitamin E was found three times as potent as pure synthetic Vitamin E. Of course the poisonous nature of the synthetic Vitamin D...is well established. WHY DO NOT THE PEOPLE AND MEDICAL MEN KNOW THESE FACTS? Is it because the commercial promoters of cheap imitation food and drug products spend enough money to stop the leaking out of information?" [16].

Table 4. Comparison of Certain Biological Effects of Food and Non-Food Vitamins

<u>Food Vitamin</u>	<u>Compared to USP/'Natural'/Non-Food Vitamins</u> [1,17-27]
Vitamin A	1.54 times more absorbed into blood
Vitamin B-1	1.38 times more absorbed into blood
Vitamin B-2	1.92 times better retained in the liver
Vitamin B-3	3.94 times more absorbed into blood
Vitamin B-6	2.54 times more absorbed into blood
Vitamin B-9	2.13 times better retained in the liver
Vitamin B-12	2.56 times more absorbed into blood
Vitamin C	3.2 to 15.6 times the antioxidant effect
Vitamin D	Over 10 times the antirachitic effect
Vitamin E	Up to 7.02 times more retained by the body
Vitamin 'H'	Over 100 times the biotin activity

The difference is more than quantitative. For example, even if one were to take 3.2 times as much of the so-called natural, non-food, ascorbic acid than food vitamin C, although the antioxidant effects might be similar *in vitro*, the ascorbic acid still will not contain DHAA [1], nor will it ever have negative oxidative reductive potential (ORP). An *in vitro* study performed at this researcher's lab with a digital ORP meter demonstrated that a citrus food vitamin C has negative ORP, but that ascorbic acid had positive ORP. It takes negative ORP to clean up oxidative damage [28], and since ascorbic acid has positive ORP (as well as positive redox potential [1]), it can never replace food vitamin C no matter what the quantity! Furthermore, foods which are high in vitamin C tend to have high Oxygen Radical Absorbance Capacity (ORAC, another test which measures the ability of foods and other compounds to subdue oxygen free radicals [27]). A US government study which compared the *in vivo* effects of a high vitamin C food (80 mg of vitamin C) compared to about 15.6 times as much isolated ascorbic acid (1250 mg) found that the vitamin C-containing food produced the greatest increase in blood antioxidant levels (it is believed that bioflavonoids and other food factors are responsible) [27]. Furthermore, it is even possible isolated ascorbic acid only has *in vitro* and no *in vivo* antioxidant effects [29]—yet high vitamin C foods have both [27,29].

Let's take vitamin E as another example—the body has a specific liver transport for the type of vitamin E found in food [10]—it does not have this for the synthetic vitamin E forms (nor for the 'new' vitamin E analogues that are frequently marketed)—thus no amount of synthetic vitamin E can truly equal food vitamin E—the human body actually tries to rid itself of synthetic vitamin E as quickly as possible [26]. As another example, it should be understood that certain forms of vitamin analogues of B-6 [19], D [10], and biotin [1] have been shown to have almost no vitamin activity.

Fractionated, synthetic, vitamins do not replace all the natural function of food vitamins in the body. This is due to the fact that they are normally chemically and structurally different (they also do not have the naturally occurring food factors which are needed by the body) from vitamins found in foods (or vitamin supplements made up entirely of foods).

Food Vitamins and Non-Food Vitamin Analogues

Vitamin A/Beta-carotene: Naturally exists in foods, yet it is not a single compound, with the vitamin A primarily existing in the form of retinyl esters, and not retinol and the beta carotene is always in the presence of mixed carotenoids with chlorophyll [10].

Vitamin A acetate is from methanol, it is a retinol which is crystalline in structure [1].

Vitamin A palmitate can be fish oil [1] or synthetically derived [2]; but once isolated it bears little resemblance to food and can be crystalline in structure [1,2]. Synthetic beta-carotene is "prepared from condensing aldehyde (from acetone) with acetylene" [2]; "not much natural beta-carotene is available due to the high costs of production" [2].

Vitamin B-1, Thiamin: Vitamin B-1 exists in food in the forms of thiamin pyrophosphate, thiamin monophosphate, and thiamin [10]. The non-food thiamin mononitrate is a coal tar derivative [4], never naturally found in the body [10], and is a crystalline isolate [1] (the same is true for thiamin hydrochloride and other chloride forms).

Vitamin B-2, Riboflavin: Naturally exists as riboflavin and various co-enzyme forms in food [10]. In non-foods it is most often synthetically made with 2N acetic acid, is a single form isolate, and is crystalline in structure [1].

Vitamin B-3, Niacinamide: Primarily exists in foods in forms other than niacin [10]. Isolated, non-food, niacinamide is normally from 3-cyanopyridine and can form crystals [1]. Non-food 'niacin' is "synthesized from acetaldehyde through several chemical reactions: [2].

Vitamin B-5, Pantothenate: Naturally exists in foods as pantothenate [10]. Non-food pantothenic acid consists of pantoic acid in amide linkage to beta-alanine [30]; no pantothenic acid is naturally found in any food [10]. Non-food pantoic acid is normally made by condensing isobutyraldehyde with formaldehyde, then condensed with hydrocyanic acid. Calcium pantothenate is a synthetic enantiomer [10] and is a calcium salt [1] and is crystalline [2].

Vitamin B-6: Plants naturally primarily contain vitamin B6 in forms such as 5'-O-(beta-D-glycopyransosyl) and other pyridoxines, not pyridoxal forms [10]. Pyridoxine hydrochloride is not naturally found in the body [10], is a crystalline isolate [1], and is generally made from petroleum and hydrochloric acid and processed with formaldehyde [4]. Pyridoxal-5-phosphate is made by combining phosphorus oxychloride and/or adenosine triphosphate with pyridoxal [1]; it becomes a crystalline isolate [1] and bears almost no resemblance to food vitamin B6.

Vitamin B-9, Folate: The vitamin once known as B-9 exists in foods as folate (also known as pteroylglutamate) [10]. Pteroylglutamic acid, the common pharmacological (USP) form known as folic acid, is not found in foods, nor significantly as such in the

body [10]. Folic acid is a crystalline isolate [1] and involves petroleum derivatives in its synthesis .

Vitamin B-12: The naturally active forms are methylcobalamin and deoxyadenosylcobalamin and are found in food [10]. Cyanocobalamin is not a naturally active form [10]; it is a mixture of cobalamins and cyanide and is an isolate, which is crystalline in structure [1].

Vitamin B-x, Vitamin B-8, Vitamin B factors: PABA was once called vitamin B-x, while inositol was once called vitamin B-8. They and choline are vitamin B co-factors. The non-food versions are made from coal tar (PABA), ethylene (choline), and phytin processed with sulfuric acid (inositol) [2].

Vitamin C: Naturally occurs in fruits in two ascorbate forms with bioflavonoids [10]. Non-food, so-called ‘natural’ ascorbic acid is made by fermenting corn sugar into sorbitol, then hydrogenating it until it turns into sorbose, then acetone (commonly referred to as nail polish remover) is added to break the molecular bonds which creates isolated, crystalline, ascorbic acid. It does not contain both vitamin C forms (nor bioflavonoids), thus is too incomplete to properly be called vitamin C [2]. The patented ‘vitamin C’ compounds that are touted as less acidic than ascorbic acid also are not food (it is not possible to get a US patent on naturally occurring vitamins as found in food—anytime a health professional hears that some vitamin is patented, that should set off warning signals that it is not real food).

Vitamin D: Vitamin D is not an isolate, it exists as a combination of substances (including vitamin D3), with promoting metabolites [10]. Non-food vitamin analogues D1, D2, D3, and D4 are isolates without the promoting metabolites. USP D1 does not have appreciable antirachitic effects [10], is crystalline, and is made with benzene [1]. USP D2 is considered a synthetic form and is made by bombarding ergosterol with electrons [1] and is "recovered by solvent extraction" [2]. USP D3 and D4 are both made through irradiating animal fat [1,10,31] or through irradiating "the spinal cords and brains of cattle" [2]. Scientists are even developing a ‘new’ form of vitamin D (which is admitted to be an analogue) which is supposed to be helpful for osteoporosis [32]—natural vitamins cannot be invented! The fact that some drugs are chemically similar to vitamin D as found in foods, does not make them true vitamins. Perhaps it should be added here that the first form of vitamin D added to milk to help prevent rickets, not only did not work as the scientists said it would, it actually resulted in unnatural bone deformities [10].

Vitamin E: Natural vitamin E as found in *Foods* is [d]-alpha tocopherol (also called *RRR*-alpha tocopherol) and is never found as an isolate [10]. Interestingly, the human body has a special liver transfer protein for the food form of vitamin E which it does not have for the synthetic forms [10]. Synthetic forms include [dl]-alpha tocopherol (also called *all-rac*-alpha-tocopherol), mixed tocopherols, and any including the term acetate. Synthetic vitamin E is produced by commercially coupling trimethylhydroquinone (TMHQ) with isophytol [31]. This chemical reaction produces a difficult-to-separate mixture, though each USP E form is an isolate. The so-called ‘natural’ forms are most frequently in supplements as isolates, a way they are never found in nature.

Vitamin H, Biotin: The only active form found in nature is *d*-(+) biotin and is usually protein bound [10]. Non-food biotin is normally an isolated, synthesized, crystalline form that is not protein bound [1]. Biotin l-sulfoxide is a lesser used isolated and/or non-food form, involves pimelic acid, is an isolate, and has less than 1% of the vitamin H activity of food biotin [1].

Vitamin K: Vitamin K naturally is found in plants as phyloquinone [10]. Non-food vitamin K3 menadione is now recognized as dangerous and is a synthetic naphthoquinone derivative (naphthalene is a coal tar derivative) [1]. USP K1, though also called phyloquinone, is an isolate normally synthesized with *p*-allylic-nickel [1]. There is another form of vitamin K inadvertently formed during the hydrogenation of oils called dihydro-vitamin K1 [33]; however since the consumption of hydrogenated oils appears to be dangerous [34], it does not seem that this form would be indicated for most humans.

Types of Available Vitamins

There are really only two types of vitamins sold: food vitamins and non-food vitamins. Food vitamins will normally state something like "100% Food" on the label. Sometimes the label will also state "No USP nutrients" or "No synthetic nutrients".

Non-food vitamins, however are somewhat less obvious. First of all, no non-food vitamin this researcher has seen says "100% food" on the label and none of them state "No USP or synthetic nutrients"—thus if none of these expressions are present, it is normally safe to conclude that the vitamins are not from food. If a label states that the product contains USP vitamins or 'pharmaceutical grade' nutrients, then it should be obvious to all naturopathic practitioners that the product is not food.

However, just because a company uses the term 'natural' or 'all natural' as a description of its vitamins does not make them, in fact, natural—this is because **the US Government has no definition of natural!** Also, just because a company may have a reputation for having natural products, this does not mean its vitamins are not synthetic—carefully check the label for proof that the product is truly 100% food.

Some companies seem to confuse the issue by using the term 'food-based' on their supplement labels. **'Food-based' vitamins are almost always USP vitamins mixed with a small amount of food.** This mixing does not change the chemical form of the vitamin, so it is still a vitamin analogue and not a food vitamin (this differs from food, as true food vitamins are not simple mixture [i.e. 36]).

Some other companies (that do not use the term 'food-based') mix foods with the vitamin analogue and seem to imply that the vitamin is a food. For example, if a label states something like *Vitamin C (Vitamin C, acerola)* then it is also normally a synthetic mixed with a food. If the product were a food, it would normally state that the vitamin C was in food or from acerola and not use the term 'vitamin C' twice in a row on the label (many companies mix ascorbic acid with acerola).

Many companies use the term 'yeast-free' on their synthetic vitamin labels, apparently implying that yeast should not be used in vitamins. There are a couple of problems with this. The first is that several non-food isolated vitamins are produced by yeast, before they are industrially processed and isolated, thus it is unlikely that any multiple vitamin formula has not been partially made up of yeast, yeast extracts, or yeast by-products

[1,2]. The second problem is that nutritional yeast is not the same as brewer's yeast, which is essentially a waste by-product. Nutritional yeast is beneficial to humans and can help combat various infections [37], including according to the German E monograph, *Candida albicans*. In the text, *Medical Mycology* John Rippon (Ph.D., Mycology, University of Chicago) wrote, "There are over 500 known species of yeast, all distinctly different. And although the so-called 'bad yeasts' do exist, the controversy in the natural foods industry regarding yeast related to health problems which is causing many health-conscious people to eliminate all yeast products from their diet is ridiculous." It should also be noted, that the late W. Crook, M.D., who was perhaps the nation's best known expert on *Candida albicans*, wrote "yeasty foods don't encourage candida growth...Eating a yeast-containing food does not make candida organisms multiply" [38]. Some people, however, are allergic to the cell-wall of yeast [38] and concerned companies have the cell-wall enzymatically processed to reduce even this unlikely occurrence.

Conclusion

Most vitamins sold are not food—they are synthetically processed petroleum and/or hydrogenated sugar extracts—even if they say "natural" on the label. They are not in the same chemical form or structural form as real vitamins are in foods; thus they are not natural for the human body. True natural food vitamins are superior to synthetic ones [8]. Food vitamins are functionally superior to non-food vitamins as they tend to be preferentially absorbed and/or retained by the body [3-8,14-26]. Isolated, non-food vitamins, even when not chemically different are only fractionated nutrients [1,3,8,16,18].

Studies suggest that the bioavailability of food vitamins is better than that of most isolated USP vitamins [e.g. 1, 17-26], that they may have better effects on maintaining aspects of human health beyond traditional vitamin deficiency syndromes [5,10,28], and at least some seem to be preferentially retained by the human body [8,17,26]. It is not always clear if these advantages are due to the physiochemical form of the vitamin, with the other food constituents that are naturally found with them, or some combination [3,16,20,33]. Regardless, it seems logical to conclude that for purposes of maintaining normal health, natural vitamins are superior to synthetic ones [8]. Unlike some synthetic vitamins, no natural vitamin has been found to not perform all of its natural functions.

The truth is that only foods, or supplements composed of 100% foods, can be counted on as not containing non-food vitamin analogues. Naturopaths are supposed to build health on foods or nutrients contained in foods. That was the standard set for the profession in 1947—that standard—that commitment to real naturopathy should remain for naturopaths today.

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