Reassessment of Some Fruit and Vegetable Pectin Levels

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ABSTRACT

Several reviews of pectin as a soluble fiber have included unreliable tables of pectin content for fruits and vegetables. Values given for ranges of pectin content in the fresh, edible portion are actually presented in original reports variously as peel pectin content, dry weight values, soluble rather than total pectins, and some values have been for unripe fruit. This has resulted in reporting pectin levels for some products that may be 2-10 times higher than other published data on the same product. This report examines the original sources and errors of such data and, when available, provides other more substantiated published values.

Key Words: pectin, fruit, vegetable, citrus

INTRODUCTION

Considerable evidence suggests that dietary supplementation with pectin may reduce levels of serum total cholesterol, decrease low density lipoprotein cholesterol, and moderate the glucose response (Baker, 1994; Reiser, 1987). Pectin supplements may be used to achieve these goals but they are bulky, often difficult to consume, and are otherwise non-nutritious. Dietary pectin levels approaching physiological effectiveness could conceivably be attained through judicious selection of foods, providing the benefit of additional nutrition. Thus, considerable importance is placed on accurate estimates of pectin amounts provided by various fruits and vegetables and their component parts. Such information would permit dietary augmentation with natural foods, avoiding the need for supplementation with refined pectin.

Pectin content values published and cited for some fruits and vegetables are substantially in error. Several pectin values are erroneously higher than other, more accurately substantiated published values. A 1978 review of the potential of pectin contained a similar tabular values were 4% pectin. If consumed with juice sacs, the membranes would no doubt provide additional pectin (Baker, 1994). Braddock and Graumlich (1981) separated the edible portion of a lemon into juice, seeds, juice sacs, and membrane, and found that membranes constituted 3% of the edible portion, and were 4% pectin. If consumed with juice sacs, the membranes could add another 1% pectin.

Lemons. Range given in Campbell and Palmer: 2.80–2.99%. As with grapefruit, these values appear in Kertesz’s discussion of lemon peel. Again, Kertesz made no mention of pectin levels in the edible portion of lemon fruit. A more reliable analysis of the pectin content values published and cited for some fruits and vegetables are actually presented in original reports variously as peel pectin content, dry weight values, soluble rather than total pectins, and some values have been for unripe fruit. This has resulted in reporting pectin levels for some products that may be 2-10 times higher than other published data on the same product. This report examines the original sources and errors of such data and, when available, provides other more substantiated published values.

Examination of the original references reveals that few of the pectin level ranges listed by Campbell and Palmer are accurate. Values given by Zilversmit were actually presented as ranges, or expressed as calcium pectate. In most cases, the values provided by Campbell and Palmer as ranges may be found in Kertesz’ text, and were mispresented to varying degrees. Eight of the values were given in Kertesz’ study as pectic acid rather than calcium pectate, incurring an error of several percent. More importantly, three of the values from Kertesz were for soluble rather than total pectins, one for protopectin content, three for pectin content of unripe fruit, and two for specific tissues of a vegetable. One pectin value listed in Campbell and Palmer and in Zilversmit as an average was reported by Kertesz as the high value for a single variety. One value listed in Campbell and Palmer as the maximum pectin level for a fruit was reported by Kertesz as its minimum. The most significant misrepresentation occurred with five values given by Campbell and Palmer as pectin ranges for fresh weight In Kertesz, four of these were for pectin contents of edible fruit peel, and the other was a dry weight value.

To prevent further dissemination of such unreliable, spurious values, a review was performed to examine the apparent sources and errors of these “ranges,” and to provide more substantiated published data. Discussions of specific products are presented in approximate order of the degree of deviation of their pectin content from more established, reliable values.

Comparisons of pectin contents

Grapefruit. Range given in Campbell and Palmer: 3.30–4.50%. The values given for fresh weight pectin levels in citrus fruits by Campbell and Palmer and by Zilversmit are among the most egregiously incorrect. The range quoted by Campbell and Palmer for grapefruit is reported in Kertesz as a range of total pectin levels for fresh seedless grapefruit peel. Also, none of Kertesz’ discussion of pectin levels in grapefruit pertains to the edible portion of the fruit. Far more reliable values for pectin content of grapefruit edible portions were given by Sinclair and Crandall (1954), who reported pectin (as calcium pectate) constituted 0.3% of grapefruit pulp fresh weight. Similarly, Atkin and Roux (1958) and Wenzel et al. (1956) found pectin levels (as calcium pectate) in cut grapefruit sections ranged from 0.24–0.27% and 0.34–0.51%, respectively (Table 2). These values were slightly lower than that found by Braddock and Graumlich (1981), who reported 0.65% pectin (as AGA) in juice sacs from Marsh grapefruit. Cut sections have segment membranes removed, and consumption of grapefruit segments with membranes would no doubt provide additional pectin (Baker, 1994). Braddock and Graumlich (1981) separated the edible portion of Marsh grapefruit into juice, seeds, juice sacs, and membrane, and found that membranes constituted 28% of the edible portion, and were 4% pectin. If consumed with juice sacs, the membranes could add another 1% pectin.
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The fresh peeled lemon fruits for pectin content was 0.63%, expressed as anhydrogalacturonic acid or AGA (Vollendorf and Marlett, 1993). 

**Oranges.** Range given in Campbell and Palmer: 2.34–2.38%. These values do not appear in any of the discussion of orange fruit by Kertesz, and their derivation is unknown. The values suggest they may have been derived from assays of peel or extracted wet pulp. For example, Rouse (1953) reported pectin (as calcium pectate) in wet centrifuged pulp of four cultivars of sweet oranges. The range for sweet oranges was somewhat lower, 0.25–0.76%, average 0.59%. This was in excellent agreement with the values of the original reference shows the value was for bitter oranges. The range for sweet oranges was somewhat lower, 0.25–0.76%, average 0.59%. This was in excellent agreement and confirmed by the work of Ross et al. (1985), who found 0.57% pectin (as AGA) in orange flesh. 

**Beans.** Range given in Campbell and Palmer: 0.27–1.11%. Although both values were found in Kertesz’ discussion, neither represents a range to be expected in fresh beans. The 0.27% was the grams of total pectin per 100 beans, not per 100g of beans. The upper range value of 1.11% was a dry weight value for the percent total pectin in snap beans. Fresh green beans were analyzed for pectin by Ross et al. (1985), who reported levels from 0.43–0.63%, as AGA. dried beans would obviously be higher in pectin levels. Vollendorf and Marlett (1993) reported total pectin weight levels of bean cultivars ranging from 1.4–29%. dry weight basis. However, pectin levels of the same beans after cooking ranged from 0.27–0.65%, quite similar to levels reported in freshly cooked beans. 

**Carrots.** Range given in Campbell and Palmer: 1.17–2.92. No range of fresh weight pectin values for carrots was given by Kertesz, although the 1.17 and 2.92 values appeared in a table. The 1.17 value was not a minimum value for pectin, but the percentage of propectin in carrot stele (core). The 2.92 value represented total pectic substances of carrot cortex, rather than whole carrot. These values were higher than later determinations of pectin in carrots by Fuchigami et al. (1995) reported 0.63% total calcium pectate in fresh carrot. Similarly, Greve et al. (1994) found 0.71–0.76% pectin (as AGA) in two cultivars, and Fuchigami et al. (1995) reported 1.6% pectin (as AGA) in a Japanese carrot cultivar. Ross et al. (1985), working with an unknown cultivar, obtained 0.59%, as AGA, quite close to the 0.86% derived from the data of Voragen et al. (1983). 

**Apples.** Range given in Campbell and Palmer: 0.71–0.84% pectin, as calcium pectate. These values appear in Kertesz, but they were given as minimum levels of pectic acid found in eating and cooking apples, respectively. The same table gave the ranges in pectic acid content for eating apples as 0.71–0.93%, and for cooking apples, 0.84–1.60%. A more extensive compilation of pectin content analyses in apples was given by Money and Christian (1950), who reported a range of 0.14–0.96% (average 0.53%) pectin as calcium pectate in 58 samples of eating apples, and a range of 0.19–0.79% (average 0.55%) in 40 samples of cooking apples. Later reports of calcium pectate levels ranged from 0.63–1.15 (average 0.79%) in nine cultivars of apples from India (Gautam et al., 1986), and from 0.32–0.72% in seven cultivars from Japan (Kawahata and Sawayama, 1974a). Pectin levels (as AGA) of Golden Delicious apples were reported from 0.28% (Forni et al., 1989) to 0.54% (Voragen et al., 1983) to 0.63% (Gleim and Pooovaiah, 1990), while the levels of pectin (as AGA) declined from 0.35 to 0.25% during ripening of Cox’s Orange Pippin apples (Knee, 1973). Ross et al. (1985) reported a range of pectin (as AGA) in two cultivars of 0.39–0.49% (Table 2). 

**Apricots.** Range given in Campbell and Palmer: 0.71–1.32%. This range was cited in Kertesz, but the values were for pectic acid. Calcium pectate contains 7.6% calcium, therefore calcium pectate yields would be from 5–10% higher than the pectic acid acid weights (Kertesz, 1951). Values from Money and Christian (1950) were quite similar, with a range from 0.42–1.32%, average 0.99%, as calcium pectate. 

**Bananas.** Range given in Campbell and Palmer: 0.59–1.28%. Both values are found in Kertesz. The lower range value was total pectic substances (as calcium pectate) of unripe Laetacian bananas, while the higher value was for total pectic substances of this cultivar after 5 days storage in a ripening room. Values for this and two other cultivars ripened for 9 days ranged from 0.58–0.89% (average 0.73%). Kawabata and Sawayama (1974a) examined bananas from three countries, and found levels of calcium pectate from 0.55–0.68%, with an average of 0.63%. This was in good agreement with the range of 0.5–0.7% pectin which had been reported by Garces Medina (1968). Wade et al. (1992) later reported total uronic acid levels of banana decreased from 1.02% to 0.44% during 8 days ripening. 

**Cherries.** Range given in Campbell and Palmer: 0.24–0.54%. In Kertesz’s discussion of cherry pectins these values were referred to as pectic acid, rather than calcium pectate, as indicated by Campbell and Palmer and by Zilversmit. A more extensive study of 30 samples of established cultivars reported calcium pectate from 0.40 to 1.19%, average 0.63% (Money and Christian, 1950). 

**Blackberries.** Range given in Campbell and Palmer: 0.68–1.19%. These values appeared in Kertesz as ranges for fresh weight pectin values from five samples of blackberries, but were expressed as pectic acid rather than calcium pectate, as indicated by Campbell and Palmer and by Zilversmit. A more extensive study cited by Kertesz (Money and Christian, 1950) gave average values of 0.16, 0.32, 0.28 and 0.31% calcium pectate for Morella, black, red and white cherries, respectively. The range for 46 samples was 0.01–1.15%. Voragen et al. (1983) reported 0.52% pectin (as AGA) in morello cherries, while Facteau (1982), in a study of fresh Lambert cherries from 5 orchards and Bing cherries from 4 orchards, reported AGA levels of 0.34–0.40% and 0.36–0.46%, respectively. 

**Dewberries.** Range given in Campbell and Palmer: 0.51–1.00%. The 0.51 value for Dewberry was for solube, rather than total pectin content of a single sample of ripe berries. The 1.00 value was total pectin for unripe berries. 

**Grapes.** Range given in Campbell and Palmer: 0.09–0.28%. These values were cited by Kertesz from a study of pectin levels in ripening grapes. The 0.09 value was for solube mature Zinfandel grapes, while the 0.28 value was for solube pectin levels of immature Tokay grapes. A graph of total pectin values for maturing Concord grapes given by Kertesz showed levels of 0.0-0.65% in mature fruit. This was in close agreement with and confirmed by work of Silacci and Morrison (1998), who reported total pectin levels in two wine grape cultivars of
<table>
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<th>Food</th>
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<th>Comments</th>
<th>Reference</th>
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<tr>
<td>Apples</td>
<td>0.14±0.96 CaP</td>
<td>eating cvs., 58 samples</td>
<td>Money &amp; Christian (1950)</td>
</tr>
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<td>0.19±0.79 CaP</td>
<td>cooking cvs., 48 samples</td>
<td>Money &amp; Christian (1950)</td>
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<td>0.63±1.15 CaP</td>
<td>9 cvs., some tropical</td>
<td>Gautam et al. (1988)</td>
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<td>Apples</td>
<td>0.39 AGA</td>
<td>Golden-Delicious cv.</td>
<td>Forni et al. (1989)</td>
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<tr>
<td>Apples</td>
<td>0.54 AGA</td>
<td>Golden-Delicious cv.</td>
<td>Voragen et al. (1983)</td>
</tr>
<tr>
<td>Apples</td>
<td>0.82 AGA</td>
<td>Golden-Delicious cv.</td>
<td>Glenn &amp; Provenow (1990)</td>
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<td>Apples</td>
<td>0.39-0.49 AGA</td>
<td>Two-unamed cvs.</td>
<td>Ross et al. (1985)</td>
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<tr>
<td>Apples</td>
<td>0.35-0.39 AGA</td>
<td>Cox’s Orange Popin</td>
<td>Krue (1973)</td>
</tr>
<tr>
<td>Apricots</td>
<td>0.42-1.32 CaP</td>
<td>44 samples</td>
<td>Money &amp; Christian (1950)</td>
</tr>
<tr>
<td>Bananas</td>
<td>0.44±1.02 GA</td>
<td>Ripening of Williams cv.</td>
<td>Wade et al. (1992)</td>
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<td>Bananas</td>
<td>0.55±0.88 AGA</td>
<td>Cs. from 3 countries</td>
<td>Kawabata &amp; Sawayama (1974a)</td>
</tr>
<tr>
<td>Bananas</td>
<td>0.58±0.99 CaP</td>
<td>3 cvs., ripened</td>
<td>Kertesz (1951)</td>
</tr>
<tr>
<td>Bananas</td>
<td>0.3-0.7</td>
<td>ripe</td>
<td>Garcia-Medina (1985)</td>
</tr>
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<td>Beans</td>
<td>0.43±0.03 AGA</td>
<td>fresh green beans</td>
<td>Ross et al. (1985)</td>
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<tr>
<td>Beans</td>
<td>0.27±0.03 AGA</td>
<td>dried, cooked</td>
<td>Vollendorf &amp; Marlett (1993)</td>
</tr>
<tr>
<td>raspberries</td>
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<td>30 samples, cultivated cvs.</td>
<td>Money &amp; Christian (1950)</td>
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<td>0.71±1.01 AGA</td>
<td>Two samples, unknown cvs.</td>
<td>Ross et al. (1985)</td>
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<td>0.53 AGA</td>
<td>unknown cv.</td>
<td>Kawabata &amp; Sawayama (1973)</td>
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<td>0.48 AGA</td>
<td>two cvs.</td>
<td>Voragen et al. (1983)</td>
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<td>0.71±0.16 AGA</td>
<td>two cvs.</td>
<td>Grov et al. (1994)</td>
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<td>1.0 AGA</td>
<td>Kuroda-Gosan-ninjin cv.</td>
<td>Fuchigami et al. (1995)</td>
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<td>Cherries</td>
<td>0.34±0.40 AGA</td>
<td>Lambert cv., 3 cvs.</td>
<td>Facteau (1992)</td>
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<tr>
<td>Cherries</td>
<td>0.36±0.46 AGA</td>
<td>Bing cv., 4 cvs.</td>
<td>Facteau (1992)</td>
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<tr>
<td>Cherries</td>
<td>0.01±1.15 CaP</td>
<td>4 cvs., 46 samples</td>
<td>Money &amp; Christian (1950)</td>
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<tr>
<td>Dewberries</td>
<td>0.70</td>
<td>One sample, total pectins</td>
<td>Kertesz (1951)</td>
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<td>Grapes</td>
<td>0.7±0.8 AGA</td>
<td>Two wine grape cvs.</td>
<td>Silacci &amp; Morrison (1990)</td>
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<td>Grapes</td>
<td>0.05</td>
<td>Concord (approx. from graph)</td>
<td>Kertesz (1951)</td>
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<tr>
<td>Grapes</td>
<td>0.12±0.17 CaP</td>
<td>Four cvs.</td>
<td>Kawabata &amp; Sawayama (1974a)</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>0.24±0.27 AGA</td>
<td>Cut sections</td>
<td>Abrikos &amp; Rouze (1938)</td>
</tr>
<tr>
<td>Grapefruit</td>
<td>0.34±0.51 AGA</td>
<td>Cut sections</td>
<td>Wenzel et al. (1936)</td>
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<tr>
<td>Grapefruit</td>
<td>0.30 AGA</td>
<td>Two samples</td>
<td>SNOCIAR &amp; GRANDEL (1954)</td>
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<td>Grapefruit</td>
<td>0.55 AGA</td>
<td>Marsh cv.</td>
<td>Brandt &amp; Germain (1981)</td>
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<td>Lemons</td>
<td>0.63 AGA</td>
<td>unknown cv.</td>
<td>Vollendorf &amp; Marlett (1993)</td>
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<tr>
<td>Oranges</td>
<td>0.57 AGA</td>
<td>One sample, unknown cv.</td>
<td>Ross et al. (1985)</td>
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<td>Oranges</td>
<td>0.57±0.09 CaP</td>
<td>8 samples</td>
<td>Money &amp; Christian (1950)</td>
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<tr>
<td>Raspberries</td>
<td>0.10±0.88 CaP</td>
<td>264 samples</td>
<td>Money &amp; Christian (1950)</td>
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<td>Squash</td>
<td>0.67</td>
<td>Winter squash, one cv.</td>
<td>Kertesz (1951)</td>
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<td>Sweet pot.</td>
<td>0.76</td>
<td>At harvest</td>
<td>Kertesz (1951)</td>
</tr>
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<td>Sweet pot.</td>
<td>0.67 AGA</td>
<td>unknown cv.</td>
<td>Vollendorf &amp; Marlett (1993)</td>
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</tbody>
</table>

*CaP* = calcium pectate; *AGA* = anhydrogalacturonic acid

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0.7–0.8%, as AGA. However, Kawabata and Sawayama (1974a) found a much lower range from 0.12–0.17% as calcium pectate, in four cultivars.

**Loganberries.** Value given in Campbell and Palmer: 0.59%. This value was cited by Kertesz, from the work of Money and Christian (1950).

**Raspberries.** Average value given in Campbell and Palmer: 0.97%. In Kertesz, this was the high value for one cultivar of raspberry. Kertesz quoted the more expansive study of Money and Christian (1950). However, he gave a small range of values for a single cultivar, with total pectic substances reaching 0.67% at maturity, 0.66% after storage, and 0.69% after canning.

**Strawberry.** No values for this fruit were given by Campbell and Palmer. Zilversmit listed Kertesz as the source of a value of 0.75%, but this appeared to have been derived from Kawabata and Sawayama (1974a). Kertesz cited three studies, giving ranges of pectin levels in ripe strawberries of 0.60–0.73%, 0.21–0.55%, and 0.35–0.44%. Later values were within these ranges:

**Wartemelon.** Campbell and Palmer did not give values for watermelon. Zilversmit mistakenly attributed a value of 0.18% to Kertesz, when it appears to have been derived from Kawabata and Sawayama (1974a). The only fresh weight value for watermelon pectin given by Kertesz (1951) was almost an order of magnitude less, 0.02% for total pectic substances.

**Reassessing pectin levels**

Many pectin values reported in Campbell and Palmer and in Zilversmit were incorrectly derived, presumably from Kertesz (1951). More accepted values from published data are in some
cases only slightly different. For example, based on more extensive and later analyses, the ranges for pectin levels in apples and apricots should be wider, and the average for apples should perhaps be lowered from 0.78% to around 0.55% (Table 2). Pectin levels in mature banana appear to be lower, rather than higher (Wade et al., 1992); therefore their average values were skewed higher by incorporation of the value from Campbell and Palmer. Analysis of cultivated blackberries by Money and Christian (1950) suggests the range of expected pectin values should be widened, and the average adjusted downward from 0.94% to 0.63%. Values given by Campbell and Palmer for cherries appear acceptable, with later data falling within these limits. Average pectin levels of grapes were understimated by Campbell and Palmer at 0.19%, since both Concord (Kertesz, 1951) and wine grape cultivars (Silacci and Morrison, 1990) show an average pectin content of ~0.7%. However, the study of Kawabata and Sawayaama (1974a) reported pectin levels in grapes (0.12–0.17%), quite similar those given by Campbell and Palmer. Conversely, the pectin level of raspberries was overstated by Campbell and Palmer at 0.97%, when analyses by Money and Christian (1950) of 26 samples gave an average of 0.40%. For most of these fruits, misestimates of pectin levels were not extreme. Also, many are not generally consumed in quantities to provide notable amounts of dietary fiber. For those fruits and vegetables perceived to contribute appreciable dietary fiber, such as apples, carrots, grapefruit, and oranges, incorrect pectin values may misguide efforts to accurately calculate daily fiber intake. The average value of 0.20% pectin for carrots published by Campbell and Palmer, seriously overstates the level of pectin. Examination of values reported in later studies (Table 2) suggest a more reasonable content of 0.8% pectin.

Citrus fruits are strongly associated with pectin, inasmuch as a substantial portion of commercial pectin is derived from citrus peel. It is unfortunate that values for citrus pectin levels have been misidentified or misinterpreted as pertaining to the edible portion. For lemon, the result is to give values 150% higher than found in fruit flesh; for orange, 300% higher than values established by Money and Christian (1950) and Ross et al. (1985), and for grapefruit, almost 1000% higher than published values (Sinclair and Crandall, 1954; Wenzel et al., 1956; Atkins and Rouse, 1958). In all of these cases the studies referred to by Campbell and Palmer at 0.97%, when analyses by Money and Christian (1950) of 26 samples gave an average of 0.40%. Therefore, the pectin levels in fruit in these studies, but total, soluble and insoluble dietary fiber values were of Proskey et al. (1988). Although previous work showed total dietary fiber levels in orange flesh of ~3.1% (Ross et al., 1985), Hegenuen and Tucker (1990a) reported 4.41% total fiber. Of this, 33.7% was found to be water-soluble fiber, the majority presumed to be pectin. This implies a fresh weight pectin level approaching 3.25%, which is far higher than previously reported values of 0.57–0.59% (Money and Christian, 1950; Ross et al., 1985). This also suggests that 24.6% of the total dry matter would be soluable fiber. This contradicts the findings of Olson et al. (1987), who reported orange flesh contained only 6.5% soluble fiber on a dry matter basis.

The implausibility of a 4.41% fresh weight fiber level in the edible portion of oranges becomes apparent upon closer examination of the data. Both Navel and Valencia oranges for the Orange Nutrition Study were purchased at various retail outlets throughout the USA to represent typical mature shipped fruit. Fiber, ash, protein, and fat concentrations were determined by AOAC procedures, but carbohydrates were determined by difference rather than by direct measurement of sugars. As a result of the large measured fiber content, the carbohydrate level was found to be only 7.37% of fresh weight. Since carbohydrates were determined by difference, this value would include not only all soluble sugars, but also citric acid. Thus, actual sugar levels would almost certainly be ~10%. This level is inconsistent with the sugar levels reported in mature oranges of either cultivar. California Navel oranges had mean sugar levels, for fruit grown on 13 different rootstocks of 9.3% (Sinclair, 1961). Similar contradictions are seen in other studies. For example, an extensive study of Florida Valencia oranges showed that fruit picked from March 1 to June 13 averaged 8.7% total sugars (Sinclair, 1961). It seems improbable that fruit with sugar levels as low as reported in the Orange Nutrition Study could have been purchased. Some error in analysis of fiber resulted in an anomalously high soluble fiber level.

Similarly, the Grapefruit Nutrition Study reported 4.01% total dietary fiber in the edible portion, 78.2% of which was soluble fiber. This infringes a pectin level of ~3.14%, although pectin was not specifically mentioned. This contradicts previous studies of pectin in the edible portion, which reported levels ranging from 0.24–0.51% (Atkins and Rouse, 1958; Sinclair and Crandall, 1954; Wenzel et al., 1956).

Future research needs

Some values for pectin content of fresh citrus and carrot have been erroneously high, but this should not be taken as an indication that these products are low fiber sources. For example, consumption of fresh citrus fruit or carrot can provide significant dietary fiber (Table 2). It is unfortunate that many studies have expressed pectin content on a dry weight basis, without providing the fresh weight/dry weight ratio so fresh weight fiber could be calculated. Expressing pectin contents on a dry weight basis eliminates variation due to differing moisture contents. However, it does not allow the consumer to calculate total quantities consumed. The few studies that have calculated citrus pectin levels on a fresh weight basis should be reinforced with more complete studies on currently grown cultivars.

Bananas are the major fruit consumed in the temperate zone (Forsyth, 1980), and account for 30% of fresh fruit consumption in the U.S (Karat, 1995). Accurate knowledge of banana pectin and fiber content would encourage their inclusion in dietary management. Both Wade et al. (1992) and Kawabata and Sawayaama (1974b) noted a decrease in pectin levels occurring during ripening of bananas. Given the relatively wide range of consumer preferences for maturity level at consumption (Forsyth, 1980), more information is needed on pectin levels at various stages of ripening.

The limited information on bean pectin and fiber levels has been derived from relatively few cultivars. Considering the variety of beans consumed from several genera and species, and the various maturity stages consumed (immature in pod, mature green seeds, dried seeds) (Table 2), more information is needed about bean fiber and pectin values. The work of Vollendorf and Marlett (1993) greatly expanded knowledge of fiber content in dried bean cultivars, with the advantage of also measuring pectin levels in beans as cooked. Ideally, pectin or soluble fiber content of all major bean cultivars should be determined at the maturity stage(s) usually consumed. When soluble fiber or pectin contents of beans are reported, the specific cultivar, genus and species,
and state of maturity should be defined. A similar situation exists with squash, where several species and numerous cultivars are grown which differ widely in physiological maturity at harvest. When values are reported for specific named cultivars, the genus and species should be given, and the cultivar should be differentiated as a summer or winter squash.

In conclusion, unrealistically low pectin values for a specific food do a disservice to the consumer and the producer, by potentially biasing dieticians, nutritionists and others concerned with dietary fiber against that food. Unrealistically high values do an even greater disservice because they may cast doubt on the reliability of food labeling data. With the high interest in all foods containing dietary fiber, the values for pectin content of grapes given by Kertesz (1951) and Silacci and Morrison (1990) would be of more value in calculating dietary pectin intake.

In conclusion, unrealistically low pectin values for a specific food do a disservice to the consumer and the producer, by potentially biasing dieticians, nutritionists and others concerned with dietary fiber against that food. Unrealistically high values do an even greater disservice because they may cast doubt on the reliability of food labeling data. With the high interest in all foods containing dietary fiber, the values for pectin content of grapes given by Kertesz (1951) and Silacci and Morrison (1990) would be of more value in calculating dietary pectin intake.