DIETARY FIBER OF PRUNES

Ellen le Clercq and John M. Labavitch

ABSTRACT

Carbohydrate analysis of 70% ethanol-insoluble material from prunes collected from California counties was performed in order to determine fruit dietary fiber composition. Although there was some variation, the average value for fiber content (fresh weight basis) was 7.1%. Pectins were, by far, the most significant fiber component.

OBJECTIVE

To repeat the analysis of prune dietary fiber content made in 1986 in order to determine year-to-year consistency and, by analyzing samples collected from several counties, determine if fiber content varied according to the location in which prunes were grown.

PROCEDURES

Twenty samples of dried prunes were provided by the Prune Board. Fourteen of these, representing 8 counties, were analyzed for fiber content. Wherever possible, at least two samples from each county were tested.

Ethanol (EtOH) extraction of prunes. From each sample 10 prunes were pitted and diced with a razor-blade. Subsamples (± 5g) were dried in an oven at 110°C for 28 hours, to determine the moisture content.

Other subsamples (± 15 g) were homogenized with a Polytron after they had been extracted in 200 ml 75% EtOH for about 3 hours. The homogenized prunes were extracted for another 5 hours and centrifuged (GSA, 12000 g, 12 min). After washing with 100 ml 70% EtOH, the prune pellets were extracted for a second time in 200 ml 50 EtOH (for 5 hours) and washed two times with 100 ml 70% EtOH (after washing or extraction, centrifuged as above). Aliquots of the EtOH soluble material were analyzed for total sugar content colorimetrically (1). The EtOH insoluble fraction (cell wall material) was suspended in 100 ml methanol (MeOH):chloroform (1:1 v/v), extracted for a half hour, and centrifuged (GSA, 12000 g, 12 min). For a following wash with acetone, the pellet was resuspended in 100 ml acetone and extracted and centrifuged as with MeOH:chloroform. The supernatants from both washes were discarded. After drying overnight in a hood and an additional drying for 4 hours under vacuum (± 40°C), the EtOH insoluble fraction was ready for analysis. Duplicate samples were taken for the carbohydrate analysis.

Fiber analysis. The dried ethanol-washed, insoluble material was then weighed and aliquots were analyzed for their overall carbohydrate fiber content by a modification of the procedure described by Englyst et al. (2). Dried material was hydrolyzed in 2N trifluoroacetic acid (TFA) for 1 hr at 121°C so as to convert non-cellulosic materials to monosaccharides. Neutral sugars in this TFA-soluble material were then analyzed by gas-liquid chromatography (3) and assayed for acid sugars as described in reference 4. The TFA-insoluble material was then dried, dissolved in 67% sulfuric acid and assayed colorimetrically for cellulose content (5). The content of each of these fundamental components of prune carbohydrate fiber could then be expressed as a percentage of the initial prune flesh weight.

RESULTS AND CONCLUSIONS

Results of ethanol extraction. The prune samples contained water that could be removed by drying in an oven at 110°C. Values for moisture content ranged from 23-30% (w/w). See Table 1 for exact data for moisture content of each individual sample.

Experience showed that 2 extractions with ethanol and additional washes were enough to solubilize most of the non-fiber neutral sugars. The yield of a third extraction was less than 1% of the total amount of soluble neutral sugars and so was not regularly performed. A great percentage of the prune flesh was soluble in 70% ethanol; only about 10% of the fresh weight of the prunes was not extractable. Data for the amounts of ethanol insoluble material are given in Table 2.

Analysis of the ethanol soluble fraction indicated a very high amount of neutral sugars in this fraction. About 32-43% of the fresh weight of prunes is ethanol soluble neutral sugars (see Appendix 2). Because these assay values are expressed in terms of glucose and, in fact, there is a mixture of sugars in these extracts there may be some difference from the actual amounts of soluble neutral sugars. The data give certainly a good indication of why prunes are sweet.

In Table 2 the fiber content of the different prunes is given as the percentage of ethanol insoluble carbohydrates in fresh prunes. The data indicate an amount of 6.3-8.1 g fiber per 100 g fresh prunes [the mean fiber content is 7.1% (w/w) of the prunes]. This value can be somewhat misleading, however, because the samples analyzed varied somewhat in their initial moisture contents (Table 1). If the average fiber content is calculated in terms of a typical moisture content at sale (32%) the average fiber content (Fresh weight basis) is 5.9%; that is, 5.9 grams per 100 grams of fresh fruit. A small underestimation may have been made because only neutral sugars, uronic acids and cellulose were analyzed, while prunes contain also some small amounts of other fiber components (for example, lignin, which was found to represent approximately 0.2% of fresh weight in last year's study).

The composition of the fiber carbohydrates in the ethanol insoluble fraction is indicated in Table 3. The neutral sugars account for ± 26% (range 24.6-30.0%), uronic acids for ±28%, 24.3-31.3%) and cellulose for another approximately 16% (12.7-18.4%). This gives a total carbohydrate content of ±70% (66.1-72.8).

The ethanol insoluble neutral sugars consist mainly of galactose (± 50%) and arabinose (± 27%). This, combined with the relatively high uronic acid content indicates that the most important fiber component in prunes is pectin. This is in agreement with the findings in last year's study.

Because the variations in fiber content and carbohydrate composition between samples from one county are as big as those between samples from different counties, it can be assumed that the procedure of analyzing had a great influence on these variations. Factors such as sampling (10 prunes), losses by extraction, weighing errors, and inhomogeneity of the ethanol insoluble fractions (only 3-5 mg of a total amount of approximately 1.4 g was taken for analysis of the carbohydrate) may have caused small errors.

By comparing the data for the prunes from different counties, it can be concluded that no differences are found in fiber content and carbohydrate composition between the counties.

The results of the fiber analysis reported in this study indicate a somewhat lower value for fiber content than analysis based on enzyme extractions followed by gravimetric analysis of the residue. Our study shows that only about 10% of the fruit fresh weight is 70% EtOH insoluble and, thus, potentially dietary fiber. The insoluble material was then analyzed for specifically defined fiber components (Table 3 and chromatographic data not detailed).

Our presumption is that other analyses performed did not remove the large amount of very sticky low molecular weight sugars present in the prune flesh and subsequently reported some of this material to be fiber. On the other hand, the entire area of fiber analysis seems to still be muddled in controversy. We have chosen the strictest, and most highly-specific approach to fiber analysis (2) and, in so doing, may have understated prune fiber content (in a relative sense) for the purposes of comparison with other fruits which have, so far, not been given such a precise analysis.

Addendum. After this study was begun we were asked to perform an analysis of the fiber present in prune juice. Fiber components were precipitated from a sample of Sunsweet prune juice by addition of EtOH to 80% concentration. Precipitated carbohydrates were then analyzed as described above. Our study showed approximately 1 gram of fiber (primarily pectin) to be present in every 100 ml of juice.

Table 1. Moisture content of the prunes.

Sample	Moisture Content[1]
5. Butte	24.4
14. Merced	23.6
2. Sonoma	27.7
8. Sonoma	27.5
1. Sutter	29.4
6. Sutter	29.2
9. Sutter	27.4
3. Tehama	27.4
19. Tehama	23.1
7. Tulare	27.9
11. Tulare	27.0
20. Yolo	25.2
4. Yuba	25.5
10. Yuba	27.2

[1]Expressed as a percentage of fresh weight of the prunes [% (w/w)].

Table 2. Fiber content, calculated as the percentage of ethanol insoluble carbohydrates in fresh prunes.

Sample		Ethanol insoluble[1] material	Ethanol insoluble[2] carbohydrates	Fiber[1]
5.	Butte	11.7	69.5	8.13
14.	Merced	9.3	72.6	6.75
2.	Sonoma	10.3	72.4	7.46
8.	Sonoma	10.0	67.6	6.76
1.	Sutter	10.2	66.1	6.74
6.	Sutter	10.3	67.0	6.90
9.	Sutter	9.4	70.8	6.66
3.	Tehama	11.0	71.1	7.82
19.	Tehama	10.0	72.8	7.28
7.	Tulare	11.7	67.0	7.84
11.	Tulare	9.1	69.8	6.35
20.	Yolo	10.2	70.9	7.23
4.	Yuba	9.7	70.1	6.80
10.	Yuba	9.3	72.4	6.73

[1]Expressed as a percentage of fresh weight of the prunes [% (w/w)].

[2]Expressed as a percentage of the ethanol insoluble prune flesh [% (w/w)];refer to Table 3.

Table 3. Carbohydrate composition of ethanol insoluble prune flesh.

Sample	Neutral[1] sugars	Uronic[1] acid	Cellulose[1]	Total[1] carbohydrates
5. Butte	26.5	27.0	16.0	69.5
14. Merced	29.1	28.0	15.5	72.6
2. Sonoma	25.6	31.3	15.4	72.4
8. Sonoma	24.8	24.4	18.4	67.6
1. Sutter	24.6	26.6	14.9	66.1
6. Sutter	26.4	25.5	15.1	67.0
9. Sutter	25.7	31.3	16.1	70.8
3. Tehama	26.5	28.4	16.2	71.1
19. Tehama	25.7	31.0	16.1	72.8
7. Tulare	26.9	24.3	15.8	67.0
11. Tulare	26.7	30.3	12.7	69.8
20. Yolo	24.6	28.9	17.4	70.9
4. Yuba	27.2	28.8	14.1	70.1
10. Yuba	30.0	26.6	15.9	72.4

[1]Expressed as a percentage of the dry weight of the EtOH-insoluble material [% (w/w)].

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