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# Quality of vining pea varieties for deep freezing

*Kvalitet af ærtesorter af lave marværter til dybfrost*

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## Summary

In 1989 and 1990 experiments were made with 11 varieties of vining peas *(Pisum sativum* L. *convar medulare* Alef.) to determine the nutritional and organoleptic quality. The content of alcohol insoluble solids (AIS), dry matter, dietary fibre, vitamin C and sucrose was measured. The surface colour was determined by a Hunter colourimeter and sensory evaluation was carried out.

The varieties 'Marinka', 'Karisma', 'Dewdrop' and 'Solist' have a dark green colour. 'Dewdrop' has a high content of vitamin C and 'Solist' has a low content of vitamin C. The varieties 'Avola', 'Chico' and 'Lambado' have a light green colour. 'Chico' and 'Avola' have a high content of vitamin C.

The content of dietary fibre, dry matter and protein are correlated to AIS and by this to the degree of maturity. The content of these nutrients has therefore to be seen in relation to the maturity at harvest. No significant difference was found in the content of protein, dry matter or dietary fibre between the varieties, when the content of these nutrients was seen in relation to the content of AIS.

A linear correlation was found between mealiness and AIS. Thus mealiness can be estimated from the content of AIS in frozen vining peas. No correlation was found between sweetness and the content of sucrose.

**Key words:** Vining pea, *Pisum sativum* L. *convar medulare* Alef., varieties, deep freezing, quality, alcohol insoluble solids, AIS, protein, vitamin C, dry matter, dietary fibre, sugars, surface colour, sensory quality, sweetness, mealiness.

## Resumé

I 1989 og 1990 blev der udført sortsafprøvning med 11 sorter af lave marværter *(Pisum sativum* L. *convar medulare* Alef.). For at undersøge den ernæringsmæssige og den sensoriske kvalitet af de 11 sorter blev indholdet af alkohol uopløseligt tørstof (AIS), totaltørstof, kostfiber, C-vitamin og sukrose bestemt. Endvidere blev overfladefarven målt ved brug af et Hunter kolorimeter, og sorterne blev bedømt sensorisk.

'Marinka', 'Karisma', 'Dewdrop' og 'Solist' havde en mørk farve. 'Dewdrop' havde et højt indhold af C-vitamin og 'Solist' havde et lavt C-vitaminindhold.

Sorterne 'Avola', 'Chico' og 'Lambado' havde en meget lys overfladefarve. 'Chico' og 'Avola' havde endvidere et højt indhold af C-vitamin.

Indholdet af kostfiber, tørstof og protein er lineær korreleret med AIS og hermed med modenhedsgraden. Indholdet af disse næringsstoffer må derfor ses i relation til modenhed ved høst.

Der er ikke fundet nogen signifikant forskel i indholdet af protein, tørstof eller kostfibre mellem sorterne, når indholdet af disse næringsstoffer ses i relation til indholdet af AIS.

Der er fundet en lineær sammenhæng mellem melethed og AIS, således at melethed objektivt kan udtrykkes ved AIS-indholdet i frosne marværter. Derimod er der ikke fundet nogen sammenhæng mellem indhold af sukrose og sødhed, bestemt ved de sensoriske bedømmelser.

**Nøgleord:** Lave marværter, *Pisum sativum* L. *convar medulare* Alef., sorter, dybfrost, kvalitet, alkohol uopløseligt tørstof, AIS, C-vitamin, tørstof, kostfiber, protein, sukker, overfladefarve, organoleptisk kvalitet, sødhed, melethed.

## Introduction

Vined pea is a very important crop for the freezing industry in Denmark (30.000 tonnes of frozen peas per year). Only the wrinkled seeded sweet type of vining peas is used for freezing. A considerable amount is exported as frozen peas (2).

The degree of maturity is of great importance for the quality of frozen peas. Several methods are developed to predict the degree of maturity. One of the chemical methods is determination of alcohol insoluble solids (AIS) (2,3,8,15). AIS is often used as a parameter, when frozen peas are sold (2). The alcohol insoluble solids in peas consist mainly of starch, dietary fibre, protein and salts; whereas the sugars are alcohol soluble (8).

New varieties of vining peas are tested for yield, size distribution and tenderometer value (2). In cooperation with the freezing industry the most suitable varieties are selected for growing (2). In 1989 and 1990 11 varieties were tested. Only limited information about the nutritional and the organoleptic quality of peas is available; the content of vitamins, dietary fibre and protein is not commonly determined.

The aim of this study is to evaluate the quality of pea varieties, concerning nutrients, surface colour and organoleptic quality. The aim is also to develop an objective method for estimation of organoleptic quality in vining peas by correlating the content of AIS and sugars with the sensory evaluation of mealiness and sweetness respectively.

**Table 1.** Names and seed companies for the tested pea varieties.
*Navne og frøfirmaer for de undersøgte sorter af lave marværter.*

| Variety name | (seed company) |
|---|---|
| A. Avola | (Asgrow) |
| B. Cobalt | (Clause) |
| C. Lambado | (S&G) |
| D. Marinka | (Agri) |
| E. Solist | (v. Wav) |
| F. Sunroy | (R.S) |
| G. Chico | (Schäfer) |
| H. Ator | (Sperli) |
| I. Dewdrop | (Rog. Br) |
| J. Karisma | (Asgrow) |
| K. Turon | (Asgrow) |

## Materials and methods

### Varieties and harvest

11 varieties of vining peas were tested in 1989 and 1990 (Table 1). The varieties were sown in medio April and late May. They were harvested as near as possible to a tenderometer reading (TR) of 110 as described by *Grevsen* and *Kidmose* (2).

### Processing

After harvesting the peas were threshed, washed and size graded in size GI (>10.2 mm); GII (8.75-10.2 mm); M (8.2-8.75 mm); SI (7.5-8.2 mm) and SII (6.0-7.5 mm) as described by *Grevsen* and *Kidmose* (2).

The peas were blanched until inactivation of peroxidase; in 1989 they were blanched in a microwave-oven (Husqvarna micronett, 650 W) for 4 min and in 1990 they were blanched in steam at 95° for

3 min; 2½ min; 2 min; 1½ min; and 1 min respectively. After blanching the peas were frozen and stored at –24°C until analysis.

**Sensory evaluations**

Frozen samples were prepared for sensory evaluation by thawing out 4 min in a microwave-oven (Husqvarna micronett, 650 W) and subsequently heating 4 min in boiled water. A trained taste panel of 8 panelists evaluated mealiness, sweetness and pea taste on a scale of 11 points (0-10). 0 is no mealiness, sweetness or pea taste and 10 is very mealy, very sweet or much pea taste.

A visual evaluation was carried out as described in *Grevsen* and *Kidmose* (2). The green colour of the varieties was evaluated on a scale of 9 points (9 = darkest green).

**Chemical analyses**

Alcohol insoluble solids (AIS) were determined by a modified method of Townsend et al. (12). Thawed peas were blended in a Waring blender with 100 ml water. An aliquot of the blended peas was extracted with 150 ml 80 w/w% alcohol. After filtration and washing the alcohol insoluble solids were dried at 115°C until constant weight.

Dry matter content was determined on an aliquot sample of the mixed material by drying at 80°C with forced air convection for 20 hours.

Total nitrogen content was measured on milled, dry material by the Kjeldahl method using a Kjeltec apparatus. The protein content was determined by multiplying the total nitrogen content by 6.25.

200 g of peas were blended with 100 ml of water. An aliquot was used for determination of insoluble dietary fibre by use of a modified method of *Asp* et al. (1).

For determination of total vitamin C 200 g of peas were extracted with 100 ml of 0.5% oxalic acid. The blender was purged with nitrogen for 5 min, after which the mixture was homogenized for 5 min. After filtration an aliquot of the extract was treated with DL-homocysteine to reduce dehydro-ascorbic acid (DHAA) to ascorbic acid (AA) according to *Lento* et al. (4). After elimation of excess homocysteine with N-ethyl-maleimide the extract was potentiometrically titrated with 2,6-dichlorophenol-indophenol (9).

The sucrose content was analyzed by HPLC (Shimadzu). 200 g peas were homogenized with 100 g of water in a Waring blender for 5 min. The homogenate was centrifuged at 4° for 20 min at 100 g after which it was filtered and diluted. An aliquot was analysed. The HPLC analysis was carried out as reversed phase chromatography using a Supelcosil LC-$NH_2$ 25 × 4.6 mm column, 5 µm packing at 35°C and a flowrate of 2.0 ml × $min^{-1}$ with a mobile phase of 75% acetonitrile/25% water and refractive index detection.

**Surface colour**

The surface colour was determined by a Hunter colourimeter (CIE-lab). After thawing the peas were packed in several layers in petri dishes. 3 samples were measured 3 times each. The surface colour was expressed as L (intensity of lightness); a (intensity of the green colour) and b (intensity of the yellow colour).

# Results

**Alcohol insoluble solids, dietary fibre and dry matter**

The content of AIS in the frozen peas varies between 8.2-19.6% as seen in figure 1. As described in *Grevsen* and *Kidmose* (2) the tested varieties 'Karisma' and 'Solist' have a high AIS value in relation to TR value. Of the remaining varieties 'Avola' and 'Lambado' have a low content of AIS.

Only the insoluble dietary fibre has been measured, because there is only a very small amount of

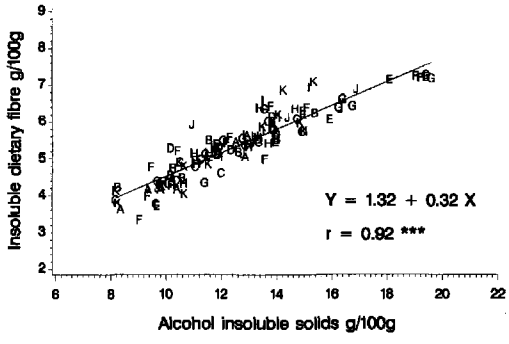


**Figure 1.** The correlation between insoluble dietary fibre and alcohol insoluble solids (AIS). A=Avola; B=Cobalt; C=Lambado; D=Marinka; E=Solist; F=Sunroy; G=Chico; H=Ator; I=Dewdrop; J=Karisma; K=Turon.
*Sammenhæng mellem uopløselige kostfibre og alkohol uopløseligt tørstof (AIS).*

soluble dietary fibre in peas. The content of insoluble dietary fibre and dry matter varies between 3.8-7.3% and 16.3-30.9% respectively. Both the content of dietary fibre and dry matter increases linearly with increasing AIS and hereby the degree of maturity. The correlation is higher for dietary fibre than for the dry matter content (r = 0.92 and 0.72 respectively). The correlation between insoluble dietary fibre and AIS for the 11 varieties is shown in Figure 1.

The content of dietary fibre and dry matter has to be seen in relation to AIS and by this the maturity stage at harvest. As described above 'Karisma' and 'Solist' have a high content of AIS, whereas 'Avola' and 'Lambado' have a low content. No significant difference was found in the content of dry matter or dietary fibre between the varieties, when the content of these nutrients was seen in relation to content of AIS.

**Protein**

The content of protein varies between 4.3-7.0% in the tested varieties. Figure 2 shows a linear correlation between the content of protein and AIS of frozen peas. When the content of protein is calculated on a dry weight basis, there is no correlation between protein and AIS.

The content of protein in the different varieties has to be seen in relation to the maturity stage at harvest as it is correlated to the content of AIS. No significant difference was found in the content of protein between the varieties, when the content of protein was seen in relation to the content of AIS.

**Vitamin C**

The content of total vitamin C in the tested varieties is shown in figure 3. No correlation was found between vitamin C and AIS. The content of vitamin C is generally higher in 1990 than in 1989. The content of vitamin C varies in 1989 between 6.33 and 29.84 mg/100g, and in 1990 between 16.90-42.69 mg/100g. In 1989 the content of vitamin C is significantly lower for the late sown than for the early sown varieties.

'Dewdrop' and 'Chico' have a high vitamin C content. 'Avola' and 'Lambado' also have a high vitamin C content. Varieties with low vitamin C content are 'Solist' and 'Karisma'. The rest of the tested varieties varies greatly in vitamin C content.

**Surface colour**

There is a significant difference in surface colour between the varieties. Yellowness and lightness vary most, and yellowness increases significantly with increasing lightness (r = 0.78). There are only small differences between the intensity of the green colour.

'Avola', 'Chico' and 'Lambado' are the the lightest and the most yellow varieties. 'Avola' and 'Lambado' also have the highest intensity of the green

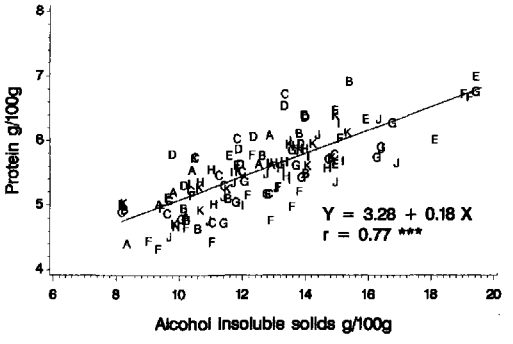


**Figure 2.** The relaton between protein and alcohol insoluble solids (AIS). A=Avola; B=Cobalt: C=Lambado; D=Marinka; E=Solist; F=Sunroy; G=Chico; H=Ator; I=Dewdrop; J=Karisma; K=Turon.
*Sammenhæng mellem protein og alkohol uopløseligt tørstof (AIS).*

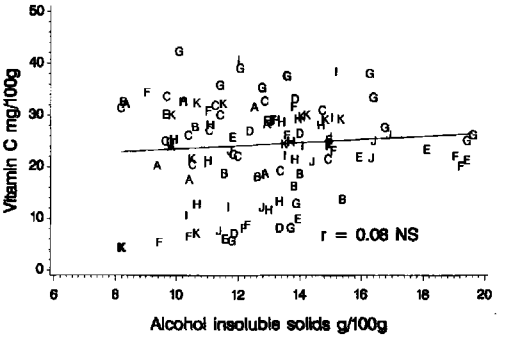


**Figure 3.** The relation between vitamin C and alcohol insoluble solids (AIS). A=Avola; B=Cobalt; C=Lambado; D=Marinka; E=Solist; F=Sunroy; G=Chico; H=Ator; I=Dewdrop; J=Karisma; K=Turon.
*Sammenhæng mellem indhold af C-vitamin og alkohol uopløseligt tørstof (AIS).*

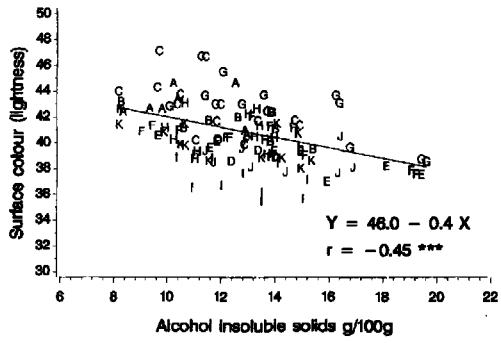


**Figure 4.** The relation between surface colour (lightness) and alcohol insoluble solids (AIS). A=Avola; B=Cobalt; C=Lambado; D=Marinka; E=Solist; F=Sunroy; G=Chico; H=Ator; I=Dewdrop; J=Karisma; K=Turon.
*Sammenhæng mellem overfladefarve (lyshed) og alkohol uopløseligt tørstof (AIS).*

colour, whereas 'Chico' has a low intensity. 'Karisma', 'Marinka', 'Dewdrop' and 'Solist' appear as very dark varieties and slightly yellow. 'Dewdrop' has a low intensity of green, whereas 'Marinka' has a high intensity.

As shown in figure 4 there is a correlation between surface colour (lightness) and AIS; but the correlation coefficient is low. No correlation was found between the intensity of green colour and AIS.

## Correlation between the organoleptic quality and objective methods

*Alcohol insoluble solids and mealiness*

In figure 5 the mealiness from the sensory evaluation is correlated with AIS for the 11 varieties. As shown in figure 5 there is a linear correlation between mealiness and AIS.

*Sucrose content and sweetness*

In the tested varieties the sucrose content varies between 3.2 and 8.2 g sucrose/100 g fresh material. No correlation was found between the sucrose content and AIS. Sweetness was determined by sensory evaluation.

As shown in figure 6 no significant correlation was found between sweetness and the sucrose content. There was neither any correlation between sweetness and the proportion between the sucrose and AIS. Sweetness decreases significantly with increasing mealiness, but the correlation coefficient is low (r = –0.59).

*Pea taste*

No correlation was found between pea taste and AIS. Pea taste increases significantly with increasing sweetness; but the correlation coefficient is low (r = 0.37).

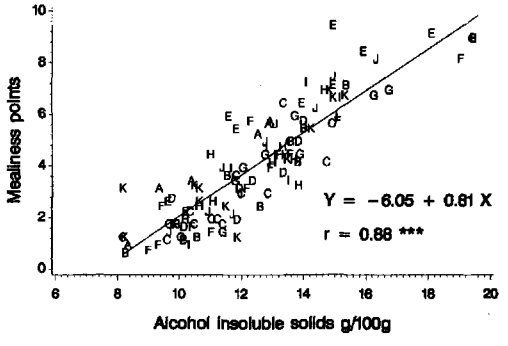


**Figure 5.** Relationship between mealiness and alcohol insoluble solids (AIS). A=Avola; B=Cobalt; C=Lambado; D=Marinka; E=Solist; F=Sunroy; G=Chico; H=Ator; I=Dewdrop; J=Karisma; K=Turon.
*Sammenhæng mellem melethed og alkohol uopløseligt tørstof (AIS).*

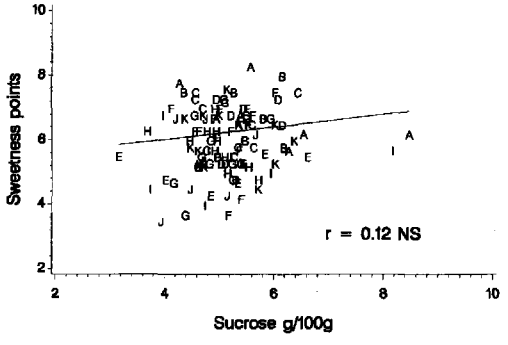


**Figure 6.** Relation between sweetness and sucrose content. A=Avola; B=Cobalt; C=Lambado; D=Marinka; E=Solist; F=Sunroy; G=Chico; H=Ator; I=Dewdrop; J=Karisma; K=Turon.
*Sammenhæng mellem sødhed og sukroseindhold.*

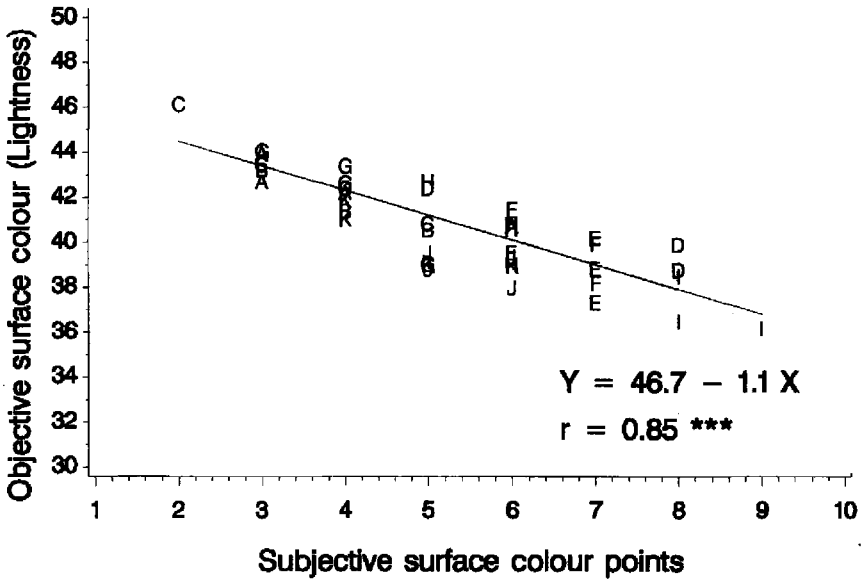


**Figure 7.** Relation between objectively measured lightness and subjective surface colour. A=Avola; B=Cobalt; C=Lambado; D=Marinka; E=Solist; F=Sunroy; G=Chico; H=Ator; I=Dewdrop; J=Karisma; K=Turon.
*Sammenhæng mellem objektiv målt lyshed og subjektiv overfladefarve.*

*Subjective and objective surface colour*
As seen in figure 7 there is a good correlation between the objectively measured lightness and the subjective surface colour from the visual evaluation. No correlation was found between the objectivly measured greeness and the subjective surface colour.

## Discussion

A linear correlation was found between dry matter, dietary fibre, protein and AIS; which means that the content of dry matter, dietary fibre and protein increases with the degree of maturity in the measured range. Dietary fibre and protein form a part of AIS (8). The content of protein increases during maturation, but only when calculated on a fresh weight basis. When calculated on a dry weight basis the protein content is constant. This is in agreement with earlier investigations (8,14).

The content of dry matter, dietary fibre and protein in the different varieties has to be seen in relation to the content of AIS, because the varieties are not all harvested at the same maturity stage and they are therefore not directly comparable. In this way 'Karisma' and 'Solist' have a significantly higher AIS value than the rest (2).

No correlation was found between total vitamin C and AIS; which means that total vitamin C content does not change with maturity. According to *Selman* and *Rolfe* (11) total vitamin C content declines with increasing tenderometer value for one cultivar. In this trial the total vitamin C content decreases with increasing maturity only for 'Cobalt'. The content of vitamin C seems to depend on cultivar, sowing date and year. This is in agreement with earlier investigations, which show that cultivar and also the sowing date have a marked effect on total vitamin C content (5,7,11).

The vitamin C content is significantly higher in 1990 than in 1989. This may be due to the different kind of blanching methods used in 1989 and 1990 or different environment conditions in the 2 years.

Concerning the surface colour it is desirable, that peas have a dark green colour (2). The visual evaluation of the surface colour showed only

good agreement with the objective measurement of lightness; therefore the L-value seems to reflect the observed changes in surface colour. On the contrary the intensity of the green colour seems to be of minor importance for the appearance of peas at the visual evaluation. In this way dark varieties which have a low intensity of the green colour are juged as "dark green" varieties. The objectively measured lightness was correlated to AIS and by this to the degree of maturity. Yellowness is correlated to lightness, which shows that the lightest varieties also are the most yellow.

A linear correlation between mealiness and AIS was found. It appears that mealiness can be estimated by the AIS content of frozen vining peas. This is in agreement with other investigations. *Schijvens* et al. (10) found a linear correlation between mealiness and AIS for samples of both smooth and wrinkled seeded peas. The correlation coefficient was 0.92.

Sweetness on the contrary cannot be estimated by the content of sucrose, as there is no correlation between the content of sucrose and sweetness. Sweetness decreases with increasing mealiness, and one of the reasons why sweetness is not correlated to sucrose content could be that mealiness covers sweetness, so that peas with high sugar content do not taste sweet, if they are mealy. Only the sucrose content has been measured, because it is the predominant sugar. The content of other sugars as fructose, glucose and galactose, is probably not importent for sweetness, because they only exist in very small amounts. The content of fructose, glucose and sucrose in raw peas is 0.16, 0.18 and 4.36 g/100g respectively (6,8).

No correlation was found between the content of sucrose and AIS. The spread of the values for sucrose is high at any given maturity stage, and the sucrose content does not seem to change appreciably in the measured range of AIS. As in these results *Nielsen* et al. (7) found a large spread of the sugar content at any maturity stage. They also found that total sugar content seems to rise and later decrease with maturity. The discrepancy could be due to the fact that *Nielsen* et al. (7) measured a larger range of maturity compared with this trial, where the peas were harvested as near as possible to a tenderometer reading of 110. According to *Nielsen* et al. (7) the total sugar content has just peaked and started to decrease nearby these tenderometer values. Sucrose, glucose and fructose seem to increase and afterward decrease at the same time (13).

## Conclusions

The varieties 'Marinka', 'Karisma', 'Dewdrop' and 'Solist' have a dark green colour. 'Dewdrop' has a high content of vitamin C; but unfortunately it also has a low yield (2). 'Karisma' and 'Solist' have a low content of vitamin C.

The varieties 'Avola', 'Chico' and 'Lambado' have a light green colour and futhermore 'Avola' and 'Chico' have a high content of vitamin C.

A linear correlation was found between dietary fibre, dry matter, protein and AIS; which means that the content of these nutrients has to be seen in relation to the degree of maturity. No correlation was found between vitamin C and AIS. No significant difference was found in the content of protein, dry matter or dietary fibre between the varieties, when the content of these nutrients was seen in relation to the content of AIS.

Correlation of the organoleptic quality with the objective measurements showed, that mealiness can be estimated from the content of AIS in frozen vining peas. There does not seem to be any correlation between sweetness and the content of sucrose. There is a good correlation between objectively measured lightness and the green colour from the visual evaluation.

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