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Comparison of processed unifloral clover and canola honey

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Summary — Although clover honey is generally considered to be superior to canola honey, the differences, if any, in the processed product are unknown. Unifloral clover and canola honey were identified by pollen analysis (each honey > 90% pollen from one floral source) and processed under the same conditions to produce liquid honey. Processed honey samples were all similar in physical properties and carbohydrate composition. Storage at 14 °C resulted in all samples starting to crystallize after approximately the same time of storage. Storage temperature and percentage moisture were more important factors in predicting crystallization than floral source. Although untrained sensory panelists could differentiate the processed clover and canola honey by taste ($P \leq 0.005$), there was no overall preference for either honey.

unifloral honey / composition / crystallization / storage / taste

INTRODUCTION

In the Canadian prairie provinces (Alberta, Saskatchewan and Manitoba) where over half of Canada's honey is produced, the dominant floral sources include clover species (*Trifolium hybridum* and *repens; Melilotus* spp) and Canola varieties (Brassicaceae). The honey samples from this region are mostly unifloral. That is, the predominant nectar collected by bees for a honey is from one plant source, as measured by the honey pollen content (> 45% of the pollen) (Feller-Demalsy et al, 1987a, b and 1989).

Many honey buyers consider clover honey a superior product and are willing to pay a premium for honey containing a minimum of 70% clover pollen. On the other hand, Canola honey suffers from comparisons with other varieties of rape honey which have perceived problems associated with color, flavor and unwanted crystal formation in liquid product (Townsend, 1979).

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The purpose of this research project was to identify the differences, if any, between a processed liquid unifloral clover and Canola honey.

MATERIALS AND METHODS

Barrels of raw honey were obtained by courtesy of the Alberta Honey Producers Co-operative Limited in Spruce Grove, Alberta. Four barrels, each containing over 250 kg of honey with similar moisture and color characteristics, were sampled using pollen analysis and two barrels chosen for processing on the basis of this analysis. Plastic containers were also obtained from the Co-operative who produced their own containers using blow molding equipment. The plastic containers were either low density polyethylene (LDPE) or polyethylene terephthalate (PETG). The Pfund Color Grader was used in the Food Quality Branch laboratory of Alberta Agriculture, Agri-Food and Rural Development, Edmonton.

Pollen analysis

A slight modification of the filtration method of Lutier and Vaissière (1993) was used. Due to filtration problems, 10% sodium hydroxide solution was substituted for 0.5% sulfuric acid as the initial solvent for the 10 g honey samples. Table I indicates the results of the pollen analysis of samples from the two honey barrels chosen for processing.

Honey processing

Honey was processed using the equipment illustrated in figure 1. The two unifloral honey samples were processed within 5 days of each other (Canola first). Raw honey was pumped into a jacketed vat (Cherry-Burrel CAS-50) and equilibrated with stirring to 43 °C. The honey was kept at this temperature for 48 h with no stirring for the last 24 h. The honey was then pumped using a screw pump (Roper 71201 GHL) at a rate of 4 kg/min through a steam heated plate heat exchanger (seven plates, Delaval PO 1VL) to reach a maximum temperature of 80 °C. The heated liquid honey was then filtered through a cartridge containing a 0.1 mm mesh metal screen into a plastic holding tank. The pressure gauge between the pump and the heat exchanger was monitored throughout the process to maintain a pressure of $\leq$ 80 psi. If this pressure was exceeded, the pump was stopped and the filter cleaned before proceeding.

Three types of containers (table II) were filled from the plastic holding tank with the temperature maintained at > 65 °C throughout the filling procedure. The thickness of representative blow-molded plastic containers was later measured using a micrometer (Moore & Wright Ltd). The containers were sealed with the appropriate screw tops and held at 45 °C for 5 days. This was considered the end of the processing period and beginning of storage studies. Containers (six of each type, 18 total for each temperature) were kept in cardboard boxes at –20 °C, 14 °C and room temperature (22 °C). Two groups of plastic containers (six of each type, 12 total) were placed in a room temperature desiccator containing water or the desiccant, Drierite (Anachemia).

Honey analyses

When necessary, crystallized samples were liquefied in a water bath at 60 °C (AOAC, 1990: method 969.38). Moisture determination was performed by measuring refractive index (AOAC, 1990; method 969.38). Color was measured using either: a) the Pfund Color Grader (Koehler Instrument Co) (Rodgers, 1979); b) by pouring 50 + 1g liquid honey into 100 x 15 mm plastic petri dishes to be read by a D25 HunterLAB (Hunter Associates Laboratory, Inc) first calibrated with a light tan yellow tile (standard no C2-7993) as suggested by Mateo et al (1992); c) by dissolving 8.3 ± 0.1g liquid honey volumetrically in 25 mL of water, filtering through Whatman no 4 filter paper and reading the absorbance at 350 nm with an 8452A diode array spectrophotometer (Hewlett Packard). Hydroxymethylfurfural (HMF) was determined using AOAC method 980.23 (AOAC, 1990) and diastase activity using AOAC method 958.09 (AOAC, 1990). Carbohydrate composition was measured using an Aminex HPX-87H resin column (BioRad) at room temperature with 0.009 N sulfuric acid solvent flow at 0.5 mL/min as described by Assil et al (1991). HPLC sample chromatograms were quantified by comparison to chromatograms of standard solutions of fructose (for fructose in the sample),

glucose (for glucose in the sample) and sucrose (for both the disaccharide and trisaccharide peaks). Crystals in liquid honey were observed as suggested by Townsend (1978) using two 12 inch x 14 inch brown polarizers (Edmund Scientific Co), with one polarizer between a light source and the honey and the other polarizer at 90° on the other side of the honey. All analyses were performed at least in duplicate.

Sensory evaluation

Triangle tests (O'Mahony, 1985) were performed on processed honey after storage at room temperature in PETG containers for 107 days and 102 days, respectively, for the Canola and clover liquid honey. The samples were presented to 50 untrained panelists as 2 to 3 cm of honey in new 75 x 10 mm test tubes. The three randomly presented samples were offered with three plastic stir sticks for tasting. Panelists were instructed to taste the samples in the order indicated cleansing the palate with the salt-free crackers and lemon water between samples. Each panelist was then asked to identify the odd sample and indicate a preference and the reason for the preference. The taste panel room was illuminated with red light, because careful observation of the samples under regular white light might allow a panelist to identify the odd sample by the slight difference in appearance. The experiments were performed in the afternoon (between 2 and 4 pm) using mainly university students as panelists.

RESULTS AND DISCUSSION

The two raw honey samples chosen for processing were not only unifloral but actually contained more than 90% of one pollen. The pollen in the Canola honey was 91.3% Brassicacea with only 4.5% clover pollen, while the clover honey contained 94.5% *Trifolium* pollen (499 pollen grains, or 93.4% *Trifolium repens*) with no Brassicaceae pollen (table I).

For the processing of the raw honey, care was taken to prepare a liquid product that would remain free from crystallization for as long as possible. For this reason the honey was filtered through a 0.1 mm screen (minimum of 0.18 mm suggested by Townsend, 1978); heated to pasteurization temperatures to dissolve all of the sugar crystals (yeast destruction is instant at 71 °C,

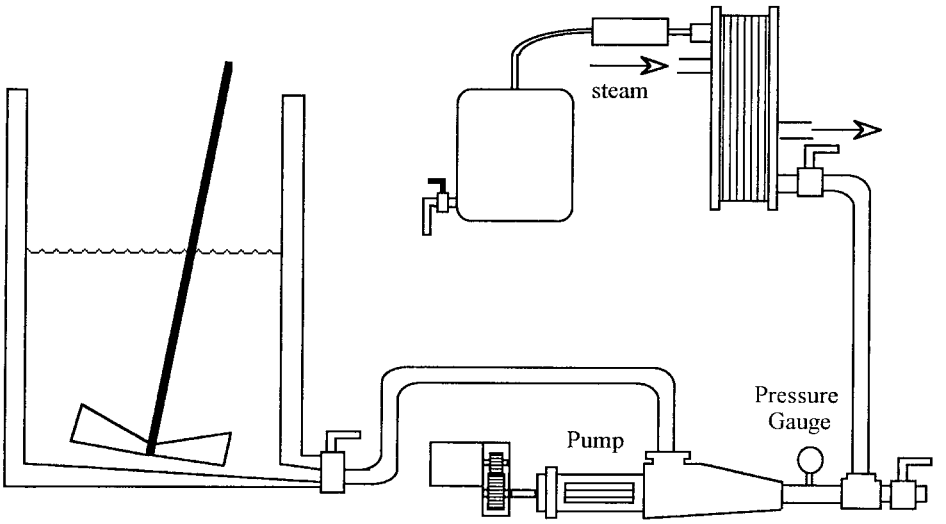

Fig 1. Schematic of honey processing equipment.

Table I. Pollen grains found in 10 g-honey samples chosen for processing.

Pollen source	*Clover honey*	*Canola honey*
Trifolium spp	505	26
Melilotus spp	15	19
Brassicaceae	0	525
Poaceae	2	2
Others	12	3

Table II. Containers used for processed honey.

Composition	*Volume used (mL)*	*Diameter (mm)*	*Height (mm)*	*Average wall thickness (mm) (max; min)*	*Diameter (mm)*	*Screw-cap seal*
Glass	200 (260)	60	100	2.5	55	Plastic
PETG plastic	330 (390)	62	125	0.62 (1.29; 0.45)	40	Plastic
LDPE plastic	265 (285)	60	110	0.76 (1.53; 0.45)	25	Aluminum

Townsend, 1978); containers were filled at > 65 °C (Assil et al, 1991) and the final liquid product was allowed to equilibrate at an elevated temperature (45 °C) for 5 days before storage.

Of course, this heating sequence changed the properties of the honey so these changes were examined by analysis of the honey prior to, during and after processing (table III). For these analyses, raw honey was compared to honey collected prior to the heat exchanger (labeled, pump honey) and to fully processed honey. These samples were stored in a freezer in glass jars before and between analyses. Looking at the analyses it was noteworthy that the two raw honey samples, obtained from totally different floral sources, were similar in the characteristics measured. The heat processing obviously changed the honey characteristics, but again, the processed honey samples were very similar. All of the parameters measured changed as expected. There was a small moisture loss for the processed honey and an increase in color, as measured by both the increased absorbance at 350 nm and the more subjective Pfund scale. Also as expected (Townsend, 1979), HMF values increased while the enzyme diastase decreased after processing. While Mateo et al (1992) were able to use the HunterLAB to differentiate unifloral honey by color, our samples were so similar that bubbles and small particles in the honey samples had a greater effect on the readings than the color of the sample. Samples that were obviously darker by visual inspection, such as the processed samples, gave lower

Table III. Changes in honey characteristics due to processing.

Honey	*Moisture %*	*Pfund units (mm)*	*Absorbance/ g Honey at 350nm*	*HMF (ppm)*	*Diastase number*
Raw canola	16.5	16.2	0.102	2.1	14.7
Pump canola	16.7	20.7	0.104	5.6	13.6
Processed canola	16.1	20.7	0.115	14.5	8.5
Raw clover	16.7	14.2	0.119	1.9	16.5
Pump clover	16.6	17.2	0.120	4.9	14.2
Processed clover	16.4	18.7	0.143	14.3	6.8

Table IV. Honey carbohydrate composition.

Honey	*Fructose*	*Glucose*	*Disaccharides*	*Trisaccharides*
Raw canola	40.0 ± 0.7	39.2 ± 1.0	5.5 ± 0.2	0.6 ± 0.1
Processed canola (–20 °C)	39.3 ± 1.2	37.6 ± 0.9	7.0 ± 0.3	0.6 ± 0.1
Processed canola (RT)	39.2 ± 1.5	37.4 ± 2.2	6.7 ± 0.2	0.6 ± 0.1
Raw clover	40.0 ± 0.7	38.2 ± 0.7	6.8 ± 0.3	1.2 ± 0.1
Processed clover (–20 °C)	40.0 ± 1.4	36.9 ± 1.5	8.4 ± 0.8	1.3 ± 0.2
Processed clover (RT)	39.1 ± 2.1	36.3 ± 1.9	8.2 ± 0.5	1.1 ± 0.1

L values on the laboratory scale than less homogeneous raw honey samples.

The major components of honey are the carbohydrates (table IV). It was of interest to examine not only carbohydrate changes due to processing, but also any carbohydrate changes during storage. This was particularly important since the sensory tests were performed on liquid honey samples that had been stored at room temperature for months. Therefore the carbohydrate analyses were performed (at least in triplicate, most in quintiplicate) on raw honey, honey that was processed and stored in a freezer, and on honey that was processed and then stored at room temperature for 2.5 months. Again the similarities of the two unifloral samples was striking, although clover honey contained more di- and trisaccharides likely reflecting the clover nectar source which contains sucrose. Canola nectar contains only glucose and fructose (Low et al, 1988). During processing the amount of disaccharides increased for both

Table V. First observed crystal formation at 14 °C.

Honey	*Time from last day of 45 °C equilibration*	*Number of containers containing crystals (no of crystals)*		
		Glass	*PETG*	*LDPE*
Canola	72 days	6 (25-40)	1 (5)	1 (3)
Clover	67 days	2 (3-5)	0	0

honey samples at the expense of monosaccharides, while there were very few further changes after storage at room temperature.

Since change in moisture level has been noted for honey stored in plastic containers (Assil et al, 1991), we carefully monitored moisture levels in our various containers. All moisture levels of individual containers were performed at least in duplicate and in many cases all six containers (desiccator samples) were analyzed for moisture. Moisture changes could not be related to plastic diffusion characteristics because of the large variations in wall thickness of the blow molded plastic containers (table II). On average the standard deviation of moisture levels between containers stored under the same conditions was ± 0.1%. As noted above, honey samples lost some moisture after pasteurization, however, further small changes in percentage moisture were noted in some of the containers. Changes were first observed after the five day equilibration at 45 °C, since the storage cabinet contained an open container of water to maintain humidity. The PETG plastic containers did not gain moisture, but all the honey samples in LDPE containers increased slightly in moisture percentage. Canola samples stored in LDPE rose from 16.1 to 16.4%, while the clover samples in these containers rose from 16.4 to 16.6%. Surprisingly the storage of the LDPE containers for 4 months at room temperature in a desiccator resulted in no further change to the average container moisture percentage. That is, containers stored for over 4 months with desiccant had the same moisture levels as containers stored with water in desiccators. However, for the PETG containers, which did not noticeably increase in moisture after the 5 days of 45 °C equilibration, there was a definite increase in moisture levels in the water-containing desiccator. Canola samples increased from 16.1% to 16.8% and clover samples increased from 16.4% to 16.9%. PETG containers stored in a desiccator with desiccant did not lose detectable amounts of moisture. While these changes in average percentage moisture were slight, they do illustrate the permeable nature of the plastic containers.

One of the major concerns of honey processors is the use of Canola honey for liquid product. The perception is that Canola honey forms glucose crystals (also known as granulation) more readily. This perception is supported by observation that fresh Canola honey crystallizes more rapidly (likely due to the less complex carbohydrate composition of the original nectar, Low et al, 1988) than fresh clover honey. The crystals are a problem in the liquid honey because consumers may reject the visibly different crystallized liquid honey. It was therefore useful to try to determine when crystallization occurred in the processed liquid honey. To speed any crystallization that

might occur, a number of samples were stored at 14 °C. It is known that this is the optimum temperature to induce honey crystallization (Townsend, 1978; Dyce, 1979). In order to find the first evidence of crystallization (table V), Polaroid films were used to detect light scattering from crystals (Townsend, 1978). Crystallization was noted first in the glass containers for both processed samples stored at 14 °C, but was rapidly followed by crystallization in the plastic containers. Within a month of the crystallization noted in table V, all containers stored at 14 °C contained ten or more visible crystals. In general, after crystallization began, the Canola sample containers contained more and larger crystals than the corresponding clover sample containers. About 1 month after the onset of crystallization at 14 °C, the amount of crystals seemed to reach an equilibrium and no large increase in amount of crystals was noticed over the next few months of storage. Honey samples stored at room temperature were free of any noticeable crystallization for at least 2 months longer than the samples stored at 14 °C and never developed as many crystals as those noted in the 14 °C samples.

Of course, one of the most important factors in the formation of crystals in honey is the moisture level (Dyce, 1979) and, as has already been noted, the moisture levels of some of the containers were slightly different. Moreover, all of the honey samples in this study were quite low in moisture. Commercial honey processors blend honeys of different moisture content to achieve final moisture percentages of 17 to 18% for liquid honey (Assil et al, 1991). Some larger honey processors also have more elaborate honey filtration systems, than our simple system, to remove fine particles that could serve as nuclei for crystal formation. If a combination of only temperature and moisture were considered, the Canola honey samples stored in glass containers (16.1% moisture) and kept at 14 °C would be expected to crystallize first as was observed. Alternately, the clover honey samples stored at room temperature in PETG plastic in the desiccator over water (16.9% moisture) would be the last to crystallize and after 7 months there was still no sign of crystallization.

The results of the sensory panel indicated that 26 out of the 50 panelists could identify the odd honey sample. Therefore, even with all of the chemical and physical similarities of the Canola and clover honey noted above, there was a significant difference ($P \leq 0.005$) in the taste of the two processed honey samples. Of the 26 panelists that correctly chose the odd sample, 14 preferred Canola and 12 preferred clover honey. The panelists were also asked the reason for their preference and the only consistent comment noted was a milder taste noted for Canola honey by 7 of the 14 panelists that preferred this honey. This is in contrast to the accepted belief of a preference for clover honey.

In conclusion the two unifloral processed honey samples had a different taste but there was no clear preference by untrained sensory panelists for one over the other. Crystallization in the processed liquid honeys proceeded in almost an identical fashion with moisture percentages and temperature of storage being the most important factors affecting crystallization. After crystallization started, Canola honey samples did eventually form more and larger crystals. Moisture levels of honey stored in plastic containers could change slightly due to changes in storage conditions. Other than the taste, unifloral clover and Canola honey samples were remarkably similar in a variety of chemical and physical properties.

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ducers Co-operative Limited as well as suggestions and encouragement from Roy Sterling, general manager of the Co-operative and Jean-Luc Paradis, past president of the Alberta Beekeepers' Association are gratefully acknowledged. Technical Assistance for set up of the processing equipment was provided by Jean Bourgois.

Résumé — Comparaison du miel monofloral de trèfle et de Canola après traitement. Deux miels monofloraux liquéfiés ont été comparés pour identifier leurs différences : le miel de trèfle et le miel de Canola (variété de colza à faible teneur en glucosinolate et acide érucique), car des problèmes liés à la couleur, au goût et à la formation indésirable de cristaux ont été signalés avec le miel de Canola. Deux fûts de miel monofloral ont été choisis : celui de Canola renfermait 91,3% de pollen de Brassicaceae et 4,5% de pollen de trèfle, celui de trèfle 94,5% de pollen de *Trifolium* et aucun pollen de Brassicaceae (tableau I). Le traitement comprenait une homogénéisation à 43 °C, suivie d'un chauffage rapide à 80 °C, d'une filtration et d'une mise en pots à une température > 65 °C (Assil et al, 1991). Les récipients (tableau II) ont été maintenus cinq jours à 45 °C à hygrométrie normale, puis conservés à –20 °C, 14 °C et à température ambiante (22 °C). Les échantillons cristallisés ont été liquéfiés. La teneur en eau a été déterminée d'après l'indice de réfraction (AOAC, 1990 méthode 969.38), la couleur soit par un colorimètre Pfund, soit par l'appareil D25 HunterLab (Mateo et al, 1992), soit par l'absorbance à 350 nm de miel dilué (8,3 g/25 mL), l'HMF et l'activité enzymatique respectivement par la méthode 980.23 et 958.09 de l'AOAC. La composition en glucides a été mesurée par HPLC (colonne sur résine HPX-87H Aminex). Les cristaux ont été dénombrés à l'aide de filtres polarisants. Des tests en triangle ont été faits sur des échantillons de miel conservés à 22 °C dans des récipients en PETG durant 107 jours pour le miel de Canola et 102 jours pour celui de trèfle. Des échantillons de miel dans des tubes de 75 x 10 mm ont été présentés en lumière rouge à un comité de 50 dégustateurs non initiés. Ils avaient à leur disposition des bâtonnets pour goûter, de l'eau citronnée et des crackers sans sel pour se rincer la bouche. On a demandé aux dégustateurs d'identifier l'échantillon différent des deux autres, de noter leur préférence et d'en indiquer les raisons. Les propriétés du miel ont été analysées avant, pendant et après le traitement sur des échantillons conservés au congélateur entre les analyses (tableau III). On a observé sur les échantillons traités une faible diminution de la teneur en eau et de l'indice diastasique et une augmentation de la couleur et de l'HMF, comme l'on s'y attendait (Townsend, 1979). Les analyses des glucides (tableau IV) faites sur le miel brut, le miel traité et le miel traité et conservé à 22 °C pendant 2 mois et demi ont montré une similitude frappante des divers échantillons, bien que le miel de trèfle ait renfermé un peu plus de di- et de trisaccharides, reflet de la source de nectar (Low et al, 1988). Le traitement a augmenté les disaccharides aux dépends des monosaccharides. De faibles augmentations de la teneur en eau ont été notées pour le miel de Canola comme pour celui de trèfle dans les récipients en plastique conservés dans des conditions de forte humidité. Un souci majeur des conditionneurs de miel est la cristallisation rapide du miel brut de Canola. La cristallisation a été notée en premier dans le miel traité et conservé dans des récipients en verre (teneur en eau minimum) stockés à 14 °C (température optimum pour la cristallisation, Dyce 1979). En 1 mois tous les récipients conservés à 14 °C contenaient au moins dix cristaux (tableau V). Un mois après le début de la cristallisation (14 °C) la quantité de cristaux a atteint un état d'équilibre et il n'y a plus eu de changements par la suite. Les échantillons conservés à température ambiante sont restés sans cristaux deux mois de plus que les échantillons conservés à 14 °C et n'ont pas

développé autant de cristaux. La cristallisation dans son ensemble est principalement due à la teneur en eau. Le comité d'évaluation sensorielle a marqué une différence significative ($P \leq 0{,}005$) pour le goût mais sans préférence pour l'un ou l'autre miel. Le seul commentaire concordant portait sur le goût plus doux du miel de Canola.

miel monofloral / composition / cristallisation / stockage / analyse sensorielle

Zusammenfassung — Vergleich von Sortenhonig von Klee und Canola nach der Abfüllung. Das Ziel dieser Untersuchung war es, Unterschiede zwischen abgefülltem flüssigen Klee- und Canolahonig aus sortenreiner Herkunft zu ermitteln, da bei Canolahonig Probleme bezüglich Farbe, Geschmack und unerwünschter Kristallisation beobachtet worden waren (Townsend, 1979). Zwei Fässer mit Sortenhonig wurden ausgesucht, wobei eines Canolahonig mit 91.3% *Brassicacea*-Pollen und 4.5% Kleepollen, das andere Kleehonig mit 94,5% *Trifolium*-Pollen ohne *Brassicaea*-Pollen enthielt. Der Abfüllungsprozess beinhaltete eine gleichmässige Durchmischung bei 43 °C, gefolgt von schneller Erwärmung auf 80 °C, Filterung und Abfüllung bei Temperaturen > 65 °C (Assil et al, 1991). Die Behälter (Tabelle II) wurden fünf Tage lang bei 45 °C bei normaler Luftfeuchtigkeit ausgeglichen und anschließend bei –20 °C, 14 °C und Raumtemperatur (22 °C) in getrockneter Luft gelagert.

Kristallisierte Proben wurden verflüssigt. Der Wassergehalt wurde anhand des Brechungsindex (AOAC, 1990; Methode 969.38) bestimmt. Die Farbe wurde mit einem Pfund Color Grader (Köhler Instrument Co), einem D25 HunterLAB (Hunter Associates Laboratory, Inc) (Mateo et al, 1992) sowie durch Messung der Absorption von verdünntem Honig bei 350 nm (8.3 g/25 mL) gemessen. Hydroxymethylfurfural (HMF) und Diastase-Aktivität wurden nach den AOAC-Methoden 980.23 bzw 958.09 bestimmt. Die Kohlenwassertstoffzusammensetzung wurde über eine HPLC Aminex HPX-87H Harzsäule analysiert (Assil et al, 1991). Die Kristalle im flüssigen Honig wurden unter Verwendung von Polarisationsfiltern gezählt. Nach Lagerung des verarbeiteten Honigs in PETG-Behältern über eine Zeitraum von 107 Tagen im Fall des Canolahonigs und von 102 Tagen im Fall des Kleehonigs wurden Dreiecksversuche durchgeführt. Hierbei wurden Proben in 75 x 10 mm Teströhrchen bei Rotlicht 50 untrainierten Testpersonen angeboten, mit Plastikstäbchen für Geschmacksproben und Zitronenwasser sowie salzfreien Plätzchen zur Reinigung des Mundes. Die Testpersonen sollten die abweichende Probe identifizieren und ihre Bevorzugung sowie deren Gründe angeben.

Die Eigenschaften des Honigs wurden sowohl vor als auch während und nach der Verarbeitung anhand von im Laufe der Verarbeitung eingefrorenen Proben bestimmt (Tabelle III). Wie zu erwarten gab es einen geringfügigen Verlust an Feuchtigkeit und Diastase, sowie eine geringfügige Zunahme der Farbwerte und des HMF-Wertes bei dem verarbeiteten Honig (Townsend, 1979). Die Analysen der Kohlenhydratzusammensetzung (Tabelle IV) an unverarbeitetem, verarbeitetem sowie bei verarbeitetem Honig nach Lagerung bei 22 °C über 2.5 Monate zeigten eine bemerkenswerte Ähnlichkeit der Proben, obwohl Kleehonig entsprechend der Nektarquelle etwas mehr Di- und Trisaccharide enthielt (Low et al, 1988). Die Verarbeitung erhöhte den Gehalt an Disacchariden auf Kosten des Gehalts an Monosacchariden. Ein leichter Anstieg des Wassergehalts wurde bei Proben von beiden Honigsorten festgestellt, wenn diese in Plastikbehältern bei hoher Luftfeuchtigkeit gelagert waren.

Eine wichtige Sorge der Honigverarbeiter ist die rasche Kristallisation des Canolahonigs. Die Kristallisation trat am frühesten auf, wenn der verearbeitete Honig in Glas-

behältern bei 14 °C gelagert war. Unter diesen Bedingungen ist der Wassergehalt am geringsten und die Temperatur optimal für eine Kristallisation (Dyce, 1978). Innerhalb eines Monats (Tabelle V) enthielten alle bei 14 °C gelagerten Behälter mindestens 10 Kristalle. Einen Monat nach Beginn der Kristallisation (14 °C) erreichte der Gehalt an Kristallen den Gleichgewichtzustand und veränderte sich während der weiteren Lagerung nicht mehr. Die bei Raumtemperatur gelagerten Proben zeigten zwei Monate länger keine Kristallbindung als die bei 14 °C gelagerten Proben und erreichten niemals die gleiche Anzahl an Kristallen. Die Gesamtkristallisation hing im wesentlichen vom Wassergehalt ab.

Die Verkostung des Honigs ergab einen signifikanten Unterschied ($P < 0.005$) des Geschmacks der beiden verarbeiteten Honige ohne eine Bevorzugung für einen der beiden. Der einzige übereinstimmende Kommentar bezog sich auf den milderen Geschmack der Canolahonigs.

Honig / Zusammensetzung / Kristallisation / Lagerfähigkeit / Geschmack

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