Section II: Food Technology

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No	Authors, affiliation, paper`s title
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1.	**Bogdan N.** *Institute of Microbiology and Biotechnology, Academy of Sciences of Moldova, Chisinau, Republic of Moldova* **Composition and characteristics of goat milk a review.**
2.	**Codină G. G., Mironeasa S., Gutt G., Todosi-Sănduleac E.** *«Stefan cel Mare» University of Suceava, Suceava, Romania;* **Influence of the golden flaxseed addition on bread quality of wheat flour with a very good quality for bread making.**
3.	**Gurmeza I., Cumpanici A., Macari A.** *Technical University of Moldova, Chisinau, Republic of Moldova* **Influence of smartfresh treatment on the storage of braeburn apples.**
4.	**Linda L., Terentii P., Caragia V., Sarandi T., Odobescu L.** *Scientific and Practical Institute of Horticulture and Alimentary Technologies, Chisinau, Republic of Moldova* **Cherry plum (Prúnus Cerasiféra) – source material and processed products.**
5.	**Mironeasa S., Codină G. G., Mironeasa C.** *«Stefan cel Mare» University of Suceava, Suceava, Romania;* **Effects of the pumpkin seed addition on bread quality of wheat flour with a very good quality for bread making.**
6.	**Morari B.** *PI Scientific and Practical Institute of Horticulture and Food Technologies, Chisinau, Republic of Moldova;* **Influence of thermal regimes during fermentation-maceration process on foaming properties of wine materials for red sparkling wine production.**
7.	**Polonska T., Mank V., Melnyk O.** *National University of Food Technologies, Kyiv, Ukraine;* **Nanostructures research of finely-dispersed mineral glauconite.**
8.	**Popovici C., Baerle A., Tatarov P.** *Technical University of Moldova, Chisinau, Republic of Moldova;* **Innovation strategies to walnut milk production.**
9.	**Romanovska Tetiana I., Oseiko Nick I.** *National University of Food Technologies, Kyiv, Ukraine;* **The features of primary processing of wool**
10.	**Ropciuc S., Leahu A., Cretescu I.** *«Stefan cel Mare» University of Suceava, Suceava, Romania;* *Victor Babeş" University of Medicine and Pharmacy, Timisoara, Romania;* **Researches on physicochemical characteristics in raw cow milk.**

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11.	**Taran N., Antohi M., Ponomariova I., Tcaciuc L., Chiriac A., Rosca T., Diacov T., Cogilniceanu T.** *PI Scientific and Practical Institute of Horticulture and Food Technologies, Chisinau, Republic of Moldova;* **Standardization activity in winegrowing and winemaking field in republic of Moldova.**
12.	**Taran N., Soldatenco E., Hristeva O., Vasiucovich S., Soldatenco O., Adajuc V.** *PI Scientific and Practical Institute of Horticulture and Food Technologies, Chisinau, Republic of Moldova;* **The influence of enzyme preparations on the stability of white dry wines to protein and colloidal cases.**
13.	**Taran N., Soldatenco E., Roșca O., Vasiucovici S.** *PI Scientific and Practical Institute of Horticulture and Food Technologies, Chisinau, Republic of Moldova;* **Influence of different rootstoks on the physical-chemical indices and quality of winematerials for sparkling wine production.**
14.	**Taran N., Soldatenco E., Vasiucovici S., Soldatenco O.** *PI Scientific and Practical Institute of Horticulture and Food Technologies, Chisinau, Republic of Moldova;* **Influence of dealcoholization process temperature on the quality of white wine chardonnay.**

ing to our observations, the biggest problem of fast-food products is cessing and food additives used in them for a longer shelf-life.

tional production might be a solution to this problem: the Romanian farms by breeding animals to be used in the famous hamburgers, thus the meat nese farms is not treated with additives and other chemical substances for , such a meat being fresh and much healthier. This solution is valid for ell, as these ones could provide fast-food restaurants with vegetables and ; developing their own activity. Therefore, the food in such public food be healthier by providing really the daily intake of fibers, vitamins, n etc. Also, the Romanian government should offer subventions for the ction, cooperating with the big fast-food restaurant chains, thus leading to having benefits not only the State (the producer) and the restaurant but as well who should be considered from the very beginning the main actor.

n be seen, a big problem of fast-food restaurants is the nutritional aggerated quantities of salt, sugar and fats found in the menus in question. get back to a food balance might be: food substitutes of salt and sugar, the etable oil at each frying or its thicker filtration, maybe the use of another ng, instead of frying, the grill, rotisserie or boiling might be used, thus improvement and enrichment of the culinary methods and recipes.

making of hamburgers in the fast-food industry the following food umbers) are used: sodium (salt), palm oil, and low quality flour, due to rdable price, all leading to a disaster recipe.

thonous factories might give special offers (alternatives) to these types of creasing thus their own productivity, and the specific roll will not be ger before reaching the consumer.

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INFLUENCE OF THE GOLDEN FLAXSEED ADDITION ON BREAD QUALITY OF WHEAT FLOUR WITH A VERY GOOD QUALITY FOR BREAD MAKING

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Abstract: The aim of this study was to analyze the effect of golden flaxseed addition in different doses (5%, 10%, 15%, 20%) in wheat flour 650 type with a very good quality for bread making in order to improve bread quality. It was analyzed bread physical (loaf volume, porosity, elasticity), textural (hardness, cohesiveness, adhesiveness, viscosity, elasticity, gumminess, chewiness), color profile (L, a, b, ΔL, Δa, Δb, ΔE), sensorial (for overall acceptability, appearance, color, flavor, texture, taste, smell, texture) and microstructure. The best results were obtained for the bread with 10-15% golden flaxseed flour addition.

Key words: wheat flour, golden flaxseed, bread, textural, microstructure

Introduction

Flax (*Linum usitatissium)* is an important oilseed crop industrial used in especially for it oil content (30÷40%) [Oomah B.D., 2001]. Two types of flaxseed are available in the world which differ in especially by them color namely golden and brown flaxseed [Barthet V.J. et al., 2014]. Almost 48% of its lipid content correspond to the alpha-linolenic acid (ALA) flaxseed being the seed with the highest content in this essential fatty acid [Rubilar M., 2010]. From the two flaxseed variety it seems that the golden one presents a high amount of ALA than the brown one [Sargi S.C. et al., 2013]. Besides ALA flaxseed also contains eicosapentaenoic (EPA) and docosahexanoic acid (DHA) all of them being precursors for producing omega-3 fatty acids type very important from the nutritional point of view [Ganokar P.M. and Jain R.K., 2013]. It appears that these acids are beneficial for preventing heart diseases, arthritis, inflammatory bowel disease, e.g. [Rakcejeva T. et al., 2007]. Also along omega-3 fatty acids flaxseed contain more than 13 % linoleic acid (an omega-6 fatty acid) and natural antioxidants such as chlorogenic acid, caffeic acid, phenolic glycoside-Q and K, kaempferol, quercetin, e.g. [Obranović M. et al., 2015] in a higher content in brown flaxseed variety [Sargi S.C. et al., 2013]. The flaxseed may contain aproximatively 30% dietary fibers [Rubilar M., 2010] from which mucilage (6%) [Mazza G. and Biliaderis C.G., 1989] and insoluble fibers (minimum 18%) in a lower amount in golden flaxseed variety [Epaminondas P.S. et al., 2011]. The flaxseed protein content is about 20% [Rubilar M., 2010] and vary due to genetic and environment conditions. Regarding it amino-acid composition it presents high levels of glutamic acid, leucine, arginine and aspartic acid with slightly higher values for the golden variety comparatively with the brown one [Oomah and Maza, 1993].

Flaxseed can be added in bread in order to improve it quality from the nutritional and physical-chemical point of view. Kaur A. et al (2013) obtained by an addition up to 10% flaxseed in whole wheat bread good results for baking and sensory properties. Also, Rakcejeva T. et al. (2007) found that by an addition of flax seed marc in wheat

wheat bread sample and Xu Y. et al. (2014) found that loaf volume of bread made with 6 and 10% flaxseed addition did not differ significantly from the control one.

The object of this study was to analyze the impact of golden flaxseed replacement (from 0% up to 20%) in wheat flour on bread quality due to it physical-chemical, textural, color profile and sensory characteristics.

Materials and methods

Commercial **wheat flour** (harvest 2015) was milled on an experimental Buhler mill from Mopan S.A. (Suceava, Romania) and golden flaxseed was provided by S.C. Enzymes and Derivates Romania. The effect of golden flaxseed ground in a domestic blender was evaluated by the addition of 5%, 10%, 15%, 20% related to the flour weight.

The **chemical composition** of the flour was determined according to international standard methods: moisture (ICC 110/1), ash content (ICC 104/1), protein content (ICC 105/2), falling number (ICC 107/1) wet gluten content (ICC 106/1) and gluten deformation index (SR 90:2007). Golden flaxseed chemical composition: moisture, protein, fat, ash was determinate according to ICC methods (2010).

The baking test was performed after the fallowing protocol: wheat flour, golden flaxseed flour in different doses (0% - control sample, 5%, 10%, 15%, 20%), 3% yeast and 1.5% salt reported to the mass of the wheat-flaxseed flour and water according to the wheat flour hydration capacity (56,3%) at 29-30°C were kneading in a mixer for approximate 15 minutes at 28-30°C and then the modeled samples was proofed for 60 minutes at 30°C, 85% relative humidity and baked for approximately 30 minutes in an electrical bakery convection oven with steam production, ventilation and humidification (Caboto PF8004D, Italy).

Physical parameters of bread (specific volume – rapeseed replacement method, porosity, elasticity) were determined according to the Romanian standard methods described in SR 91:2007 after two hours of cooling.

Color profile analysis wad done using the Konica Minolta CR–700 colorimeter. The color measurement was made by CIE Lab color system measurement. L, a, b values, the deviations from L, a, b (ΔL, Δa, Δb) and the total color difference (ΔE) were obtained, in triplicate. ΔL, Δa, Δb are deviations from L, a, b values and ΔE is the total color difference. The color profile analysis values were obtained in triplicate.

The **textural properties** of bread were measured using an electronic texture analyzer Mark-10-ESM301. The textural characteristics of bread were hardness, cohesiveness, adhesiveness, viscosity, elasticity, gumminess, chewiness.

The bread microstructure was analyzed using the MoticSMZ–140 stereo microscope with the 20x objective to a resolution of 2048 x 1536 pixels.

Sensory evaluation for overall acceptability, appearance, color, flavor, texture, taste, smell, texture was made by a panel of twenty semi-trained judges using a preference method of nine points hedonic scale.

The **statistical analysis** was done using the Statistical Package for Social Science (v.16, SPSS Inc., Chicago, IL, USA) and Microsoft Excel 2007. A confidence interval of 95% was used in this study.

ıeat bread sample and Xu Y. et al. (2014) found that loaf volume of bread made with ınd 10% flaxseed addition did not differ significantly from the control one.

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Results and Discussion

Analytical characteristics. The chemical composition of the wheat flour indicated the following values: 0.65% ash content, 14.5% water content, 12.6% crude protein, 8 mm deformation index, 2.3 acidity and 380 s for falling number. The golden flaxseed presents the fallowing characteristics: 5.6% moisture content, 20.85% crude protein, 41.12% fat content and 3.41% ash content.

Bread physical characteristics. Figure 1 shows the variation of loaf volume, porosity and elasticity of bread depending on the different quantities of golden flaxseed (GFS) added. It is shown that an increase of the golden flaxseed flour addition in wheat flour increase the loaf bread volume, porosity and elasticity up to 15% and then decrease them at the level of 20% GFS addition.

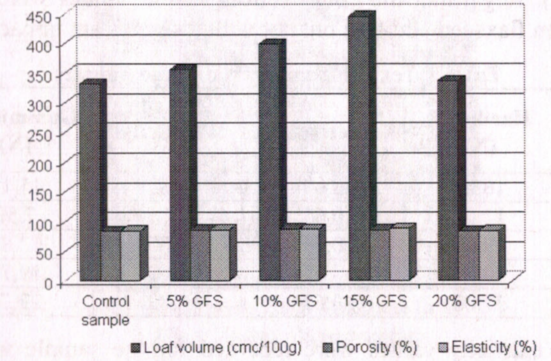


Fig.1. Bread physical characteristics

The increase of the bread physical characteristics up to 15% flaxseed addition may be due to it fat content which wraps around the gas cells and prevent its release from the dough [Meral and Dogan, 2013]. Lower values of the bread physical characteristics may be due to the gluten dilution from the system the wheat-flaxseed dough is being no longer able to retain the gas form during fermentation [Sivam et al., 2010].

Color profile analysis. Effect of golden flaxseed flour addition in wheat flour is shown in Table 1. As we can see from the Table 1, the L value for the control sample is higher. In general, the brightness values L decrease with increasing dose of golden flaxseed in bread. Similar results were also obtained by Kaur A. et al. (2013). This is may be due to a darker color of golden flaxseed flour, comparatively to white wheat flour. Compared with the control sample the value the bread with golden flaxseed flour turn presents positive values, heading to the red color. Coordinate b of the color system method CIE Lab color indicates positive values for all the samples evaluated with the increase value proportional with the increase level of golden flaxseed addition.

Table 1. Effect of golden flaxseed addition on color profile analysis of wheat bread

Sample/Golden flaxseed (GFS) addition	L	a	b	ΔL	Δa	Δb	ΔE
Control	74,46	-1,87	13,35	38,64	-15,22	-0,87	41,54
5% GFS	68,51	0,01	14,07	32,69	-13,35	-0,17	35,31

Sample/Golden flaxseed (GFS) addition	L	a	b	ΔL	Δa	Δb	ΔE
10% GFS	66,46	0,17	15,14	30,60	-13,18	1,52	33,2
15% GFS	66,43	0,33	15,75	30,50	-13,03	0,91	33,2
20% GFS	66,32	0,55	17,06	28,64	-12,80	2,84	31,4

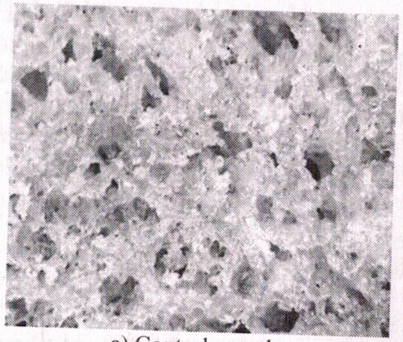
Textural properties of bread. The results obtained for the samples with an without golden flaxseed addition on textural properties of bread are shown in Table 2 The hardness of bread enriched with 20% golden flaxseed flour was approximately times higher than the control one in agreement with the results obtained by Confort F.D. and Davis S.F. (2006). This may be due to the lower water available for gluten network formation caused by the soluble fibers from the golden flaxseed according to Costa et al. (2012). Regarding the cohesiveness slower values were recorded for the samples with golden flaxseed addition but not with a significant impact.

Table 2. Textural parameters of bread samples

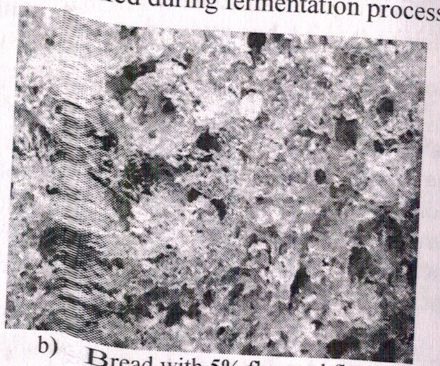
Sample/Golden flaxseed (GFS) addition	Hardness, (N)	Cohesiveness	Elasticity	Gumminess, (N)	Chewiness, (N)
Control	16,22	0,69	0,82	11,19	9,62
5% GFS	11,52	0,65	0,86	7,59	6,59
10% GFS	19,48	0,66	0,87	12,89	11,28
15% GFS	30,36	0,65	0,82	19,76	16,27
20% GFS	37,08	0,61	0,83	22,78	18,94

The higher elasticity values were recorded for the sample with 10% flaxseed addition and for the texture parameters gumminess and chewiness the maximum values were recorded for the sample with 20% golden flaxseed addition in agreement with the results obtained by Kaur A. et al. (2013).

The ***bread microstructure*** is shown in Figure 2. It may be seen that a high levels of golden flaxseed addition the porosity does not present such homogeneity like the control one. This may be due to weaker dough due to a low content of gluten which cannot retain as well as the control sample the gas formed during fermentation process.



a) Control sample



b) Bread with 5% flaxseed flour

ple/Golden flaxseed (GFS) addition	L	a	b	ΔL	Δa	Δb	ΔE
10% GFS	66,46	0,17	15,14	30,60	-13,18	1,52	33,27
15% GFS	66,43	0,33	15,75	30,50	-13,03	0,91	33,25
20% GFS	66,32	0,55	17,06	28,64	-12,80	2,84	31,49

Textural properties of bread. The results obtained for the samples with and out golden flaxseed addition on textural properties of bread are shown in Table 2. hardness of bread enriched with 20% golden flaxseed flour was approximately 3 higher than the control one in agreement with the results obtained by Conforti and Davis S.F. (2006). This may be due to the lower water available for gluten ork formation caused by the soluble fibers from the golden flaxseed according to et al. (2012). Regarding the cohesiveness slower values were recorded for the les with golden flaxseed addition but not with a significant impact.

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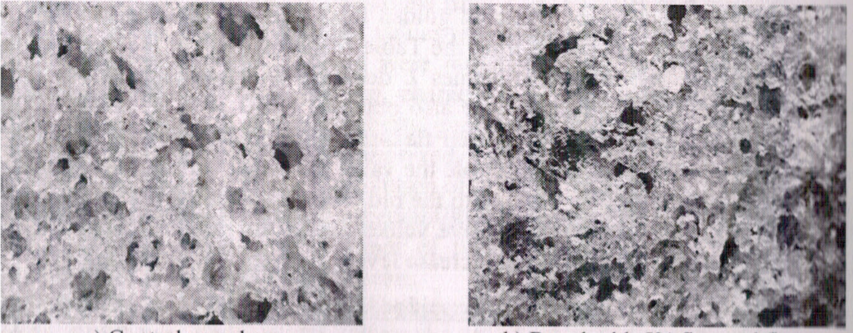
5% GFS	30,36	0,65	0,82	19,76	16,27
0% GFS	37,08	0,61	0,83	22,78	18,94

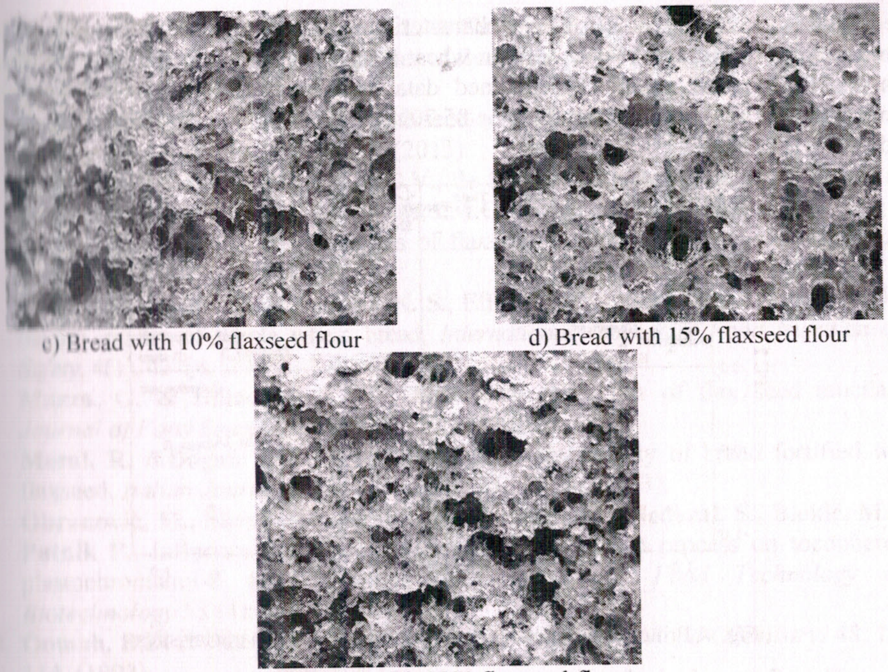
The higher elasticity values were recorded for the sample with 10% flaxseed ion and for the texture parameters gumminess and chewiness the maximum values recorded for the sample with 20% golden flaxseed addition in agreement with the s obtained by Kaur A. et al. (2013).

The ***bread microstructure*** is shown in Figure 2. It may be seen that a high levels lden flaxseed addition the porosity does not present such homogeneity like the ol one. This may be due to weaker dough due to a low content of gluten which t retain as well as the control sample the gas formed during fermentation process.



a) Control sample

b) Bread with 5% flaxseed flour



c) Bread with 10% flaxseed flour

d) Bread with 15% flaxseed flour

e) Bread with 20% flaxseed flour

Fig. 2. Bread microstructure

The ***bread sensory characteristics*** are shown in Figure 3. It may be seen that the best overall acceptability received the sample with 10% GFS addition. Also the sample with 10% GFS addition was the best evaluated from the point of view of color, taste texture and appearance. From the point of smell and flavor the best evaluated was the sample with 15% GFS addition.

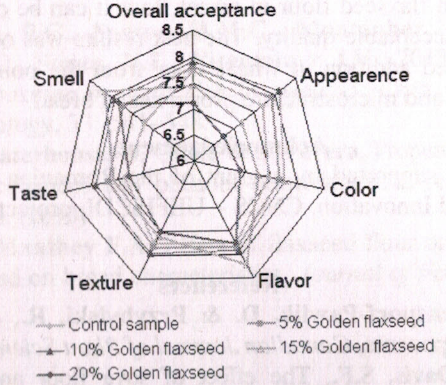


Fig. 3. The bread sensory characteristics

Relationship between the bread flour characteristics at different golden

the physical, colour, textural, sensory characteristics recorded at different substitutions levels of 0, 5, 10, 15 and 20% of GFS in wheat flour 650 type, the principal component analysis (PCA) was used. The obtained data showed that the first two principal components (Fig. 4) are responsible for 85.70% of the total variance (PC1 = 56.35% and PC2 = 29.35%).

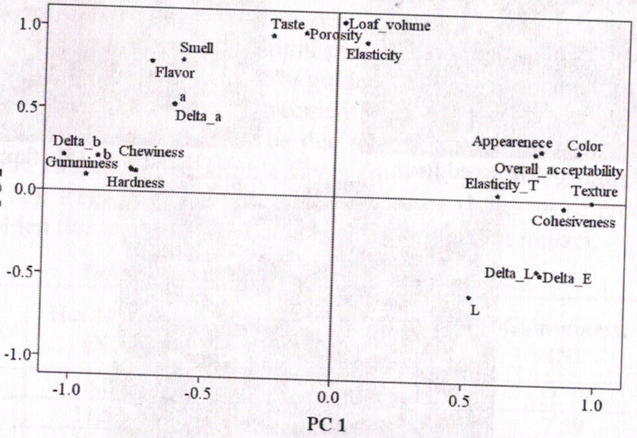


Fig. 4. Principal component analysis for the bread characteristics

The first principal component PC1 is strongly correlated with textural characteristics chewiness, gumminess, hardness ($r = 0.987$, $p < 0.01$) and cohesiveness and elasticity and sensorial characteristics appearance, colour ($r = 0.993$, $p < 0.05$) and overall acceptability ($r = 0.993$, $p < 0.05$). The second principal component PC2 shows a good correlations between colour parameters *L*, *ΔL*, *ΔE*, between *b*, *Δb* ($r = 0.956$, $p < 0.05$) and *a*, *Δa* and sensory characteristics smell and flavor ($r = 0.759$, $p < 0.05$).

Conclusions

By using golden flaxseed flour in wheat flour it can be obtain a bread improved nutritional and of an acceptable quality. The best results was obtained up to a level of 10-15% golden flaxseed addition in wheat flour from the point of physical, textural, color profile, sensorial and microstructure properties of bread.

Acknowledgements

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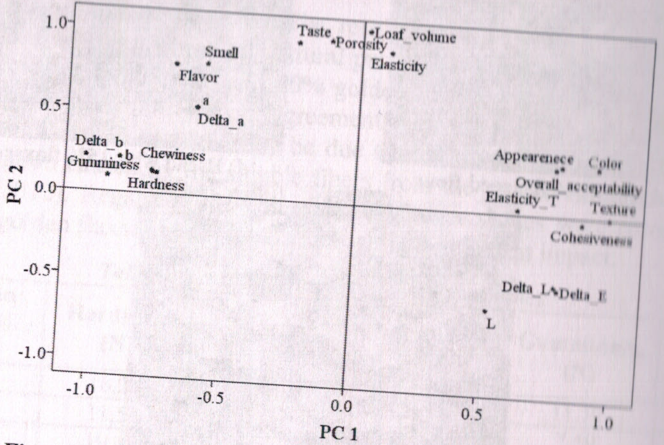

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