THE EVALUATION OF THE PALATABILITY ON A DEHYDRATED MEAT PRODUCT - MEAT FLOSS

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Introduction

Meat is well-known as an excellent protein and energy source for our daily diets. After digestion, meat provides excellent nutritional values. However, meat can be very perishable due to its high moisture and protein contents, which may be utilized by microorganisms. The principle of extending the shelf-life of meat products is to produce an unfavorable environment for microorganisms to grow. Among many preservative methods, dehydration was probably one of the earliest and most effective methods which has been developed. In this project, a new type of oriental-style of dehydrated meat product - meat floss, also called shredded pork (Chang and Huang, 1991), which possesses the advantages of long shelf-life, desirable taste, safe ingredients and low cost was first introduced by this project to the US meat industry. Of all the oriental dehydrated meat products, shredded pork is probably the most important fresh meat substitute in some areas of China, where refrigeration is not available. Its amazing long shelf-life at room temperature storage and good nutritional values have also brought great convenience to travellers and campers. It may also serve as a protein sustenance for the military, because it also has the advantages of light weight, easy-to-pack, and ready-to-eat. It can also serve as a snack or combines with other foods as daily diets for the general population. In this project, a less expensive meat source (shoulder instead of ham in traditional process) and a new, less labor-extensive processing technique with variable fat levels (2% and 12%) were applied to the shredded pork products to compare with the time and labor-intensive traditional processing method. Since little is known about this oriental product, chemical analysis (fat, protein, and moisture), biochemical properties (pH and TBA), microbiological assays (total plate count and mold growth) and sensory evaluation (color, meaty flavor, rancidity, texture, and overall acceptance) were conducted to investigate the potentials of this dehydrated meat product.

Experimental Design

The experiment was designed as a 2 (fresh & frozen) x 2 (traditional & modified) x 2 (2% & 12% lard) factorial. Boneless skinless pork shoulders were obtained from local supermarket in Columbus, Ohio. Eight approximately 5.4 lbs (2.45 kg) of boneless, skinless pork shoulders were prepared for trimming. All visible fat and connective tissue was carefully removed from the surface and internal tissue. The trimmed lean pork was then prepared for both traditional and modified method processes. The procedures for traditional method included moist-cooking (100°C, 3 1/3 hrs.), physical fiber separation, moisture evaporation (100°C, 55 min.), and was followed with a series of stir-frying (60~65 strokes/min. for 55 min.) steps. The procedures for the modified method included autoclaving (121°C, 15 psi, 30 min.), physical fiber separation, moisture evaporation (100°C, 55 min.), a series of stir-frying (60~65 strokes / min for 29 min.) combining with 15 min of hot air drying, and then a convective oven drying (93.3°C, 45 min.). All samples were vacuum-packaged and stored in a dark room at room temperature (27±2°C). Cooking yield, moisture, crude fat, and crude protein contents were accomplished at week 0. Since the pH, TBA and sensory evaluation (color, meaty flavor, rancidity, texture, and overall acceptance), total plate count and mold count were measured at week 0, 1, 3, 5, and 7 of storage, the storage time also became an additional independent variable (the fourth main effect).

Result and Discussion

The results of all measurements are summarized in Table 1. For cooking yield and chemical analysis, there was no significant three or two-way interaction between the main effects ($p < 0.05$). The results of **cooking yield (%)** are shown in Table 1. The 2% lard addition treatments (44.81%) are significantly lower than those with 12% lard addition treatments (54.68%) at the 0.05 level. This suggests that *the level of lard addition* plays an essential role on the cooking yield. For **moisture content analysis**, the treatments with 12% of lard addition had a lower percentage of moisture content (3.47%) than those with 2% of lard addition (5.23%). This was caused by the increased level of lard (fat) which will alter the proportions of other components (moisture, protein, and fat) in the meat products. In addition, it indicates that temperature of raw material and cooking method have no significant influence on the moisture content of the meat floss. The same trends are shown in **crude fat**, and **crude protein** (Table 1). The **pH** values show little or no changes during seven weeks of room temperature (27±2°C) storage. It supports the hypothesis that meat floss is a very shelf-stable product. On the other hand, it indicates that there is a few statistical differences between some of the three or two-way treatments. However these influences are very minor. **TBA value** has been commonly considered as an index of lipid rancidity. Table 1 indicates that the TBA values slightly increased during storage (0.45~0.63 μg/g). The oxygen source in a vacuum-packed bags could came from the slow rate of natural release from the internal air cells of the meat floss. As Ockerman (1985) indicated a TBA number of 1.0 is considered as the threshold level for rancidity in pork by some processors. The result also suggest that a longer than seven weeks of product shelf-life at room temperature (27±2°C) storage may be expected. **Color score** for all treatments were very consistent during the 7 weeks of storage. For **meaty flavor score**, it indicates that the level of lard addition is the main effect that influences the meaty flavor (Table 1). The results were as expected, since fat is the main factor responsible for the volatile flavor compounds of meat products. Due to more macro-molecules in meat products being degraded into smaller ones during storage, the trend of a slight increase in meaty flavor was noted. The **rancidity scores** at week 0 and Week 7 are different from each other. The slight increase of the rancidity score during the seven weeks of storage may be caused by the same reason described for the TBA values. For **texture score**, there is no significant difference at the 0.05 level in the texture scores during storage. Panels response to texture was "somewhat crispy". **Overall acceptance** indicates that three main factors, raw material temperature, lard addition, and storage time had no significant effect on the evaluation, but another main effect - the cooking method, showed that panels preferred the modified method (6.00) over the traditional method (5.88), despite the fact there was only a slight difference between these two techniques. For **microbial assays**, the LOG_{10} **TPC** numbers were very low (2.01~2.18), which indicated that the numbers of microbial flora were lower than 200/g, even after seven weeks. The results of Log_{10} CFU **mold count** were very similar to the results in TPC, both resulting in extremely low microbial growth. It indicates that the Log_{10} CFU/g for storage time treatments were very low (0.00~1.47), which means that the numbers of mold colonies were lower than 30/g during the entire seven weeks of storage. It also indicates the unfavorable growing environment (low moisture) is not suitable for bacteria or mold growth.

Conclusion

- ❑ Lard addition level is the major factor that influenced the cooking yield, chemical analysis (moisture, crude fat, and crude protein), and meaty flavor. Raw material and processing method had no significant influence on the cooking yield and chemical analysis.

- The pH, color , texture and overall acceptance did not change during storage.
- The TBA value and rancidity score were slightly increased by storage time, but were not objectionable. Rancidity was not significantly effected by raw material temperature or processing technique. The relationship between TBA and Rancidity scores are:

$$Y_i = 0.3518\,X_i - 0.5508$$

where X = Rancidity scores, Y = TBA value, i = Week 0, 1, 3, 5, and 7. ($R^2 = 0.87$)
- The numbers for TPC and mold counts are very low (TPC < 200; MC < 30) even after seven weeks of storage.

In this experiment, the results of the chemical analysis provides the basic nutritional information required by the prospective U.S. producers to modify the formulation in the area of non-meat ingredients and raw materials. In addition, consumers also can obtain nutrition and food safety information concerning this product. The low level of microbial growth during storage clearly indicated the long shelf-life. The sensory evaluation showed the potential marketing of this product, and also may imply where improvements may be made in the process. In addition, the product has a long non-refrigerated shelf-life. Also this product should be economical in cost since the raw materials were inexpensive and lower grade carcasses can be utilized, i.e., even PSE meat or two-tone muscle is acceptable (Lawrie, 1991). It is expected that shredded pork can be a popular, long-term, commercial meat snack or food additive in the U.S. In the past, most oriental products were handmade; therefore, they were always very time and labor-consuming (Harris and Chanry, 1969). With the designed modified process (modified autoclaving method) and the rapid advance of automation, meat floss can become a new product for the U.S. meat industry. The modified method saved approximately 1/2 of the original processing time (5 hours or longer). In addition, the difference between other factors (Raw material temperature and lard addition) didn't seem to have much influence on most sensory attributes; therefore, it suggests that the manufacture of meat floss is very flexible in relation to raw material and ingredient utilized. With today's advanced machinery techniques, it can be predicted that automatized processing can not only solve the equipment problem, but it can also make the commercialized mass-production of the meat floss possible in the future.

References

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Table 1. Statistical significance (at the 0.05 level) of main effects for cooking yield, chemical analysis, pH, TBA values, sensory evaluation, and microbial assays.

Treatment (Main Effects)	Raw material temperature		Cooking method		Lard addition		Storage time				
	Fresh (4 ± 2°C)	Frozen (-18 ± 2°C)	Traditional	Modified	2%	12%	Wk 0	Wk 1	Wk 3	Wk 5	Wk 7
Cooking Yield[1],%	49.94[a]	49.54[a]	49.39[a]	50.09[a]	44.81[a]	54.68[b]	N/A				
Moisture[1], %	4.37[a]	4.33[a]	4.35[a]	4.35[a]	5.23[a]	3.47[b]	N/A				
Crude Fat[1], %	24.15[a]	24.07[a]	24.15[a]	24.06[a]	16.89[a]	31.33[b]	N/A				
Crude Protein[1], %	38.71[a]	38.28[a]	38.50[a]	38.49[a]	42.90[a]	34.09[b]	N/A				
pH[2]	---	---	---	---	---	---	6.33[a]	6.33[a]	6.36[a]	6.34[a]	6.33[a]
TBA[2],μg/g	---	---	---	---	---	---	0.45[a]	0.53[b]	0.54[bc]	0.56[c]	0.63[d]
Color[3]	---	---	---	---	---	---	4.55[a]	4.39[a]	4.29[a]	4.48[a]	4.44[a]
Meaty Flavor[3]	5.51[a]	5.50[a]	5.46[a]	5.55[a]	5.32[a]	5.70[b]	5.48[a]	5.52[a]	5.37[a]	5.51[a]	5.86[b]
Rancidity[3]	3.04[a]	3.18[a]	3.11[a]	3.10[a]	3.05[a]	3.16[a]	2.92[a]	3.01[a]	3.04[ab]	3.23[ab]	3.34[b]
Texture[3]	---	---	---	---	---	---	5.70[a]	5.73[a]	5.60[a]	5.72[a]	5.64[a]
Overall Acceptance[3]	5.86[a]	6.02[a]	5.82[a]	6.07[b]	5.88[a]	6.00[a]	5.88[a]	6.02[a]	5.93[a]	5.87[a]	6.00[a]
TPC[4]	---	---	---	---	---	---	2.18[a]	2.04[a]	2.08[a]	2.12[a]	2.01[a]
Mold Count[4]	---	---	---	---	---	---	0.00[a]	1.47[b]	1.27[b]	0.81[c]	0.64[c]

a,b,c, and d; Means with different superscripts in the same attribute row indicate the significant difference at the 0.05 level ($p < 0.05$).
--- indicates three or two-way interactions were involved; therefore, they are not applicable in this table.
N/A indicates the main factor (storage time) is not applicable in three-way (Temperature x Cooking method x Lard addition) model.
[1] indicates the cooking yield and chemical analysis were done at week 0. N = 48.
[2] indicates pH and TBA were done at week 0, 1, 3, 5 and 7. N = 240.
[3] indicates sensory evaluation were done at week 0, 1, 3, 5, and 7. Trained panel number = 10. N = 800. The 9-point scale of sensory panel scores for each attribute are: 1 indicates "very light", 'bland or no", "fluffy" and "dislike extremely"; 5 indicates "medium" or "moderate" or "neither like nor dislike"; 9 indicates "very dark", "intense or pronounced", "crispy", or "like extremely'.
[4] indicate the microbial assays were done at week 0, 1, 3, 5, and 7. Total plate count and mold count were expressed as Log_{10} CFU/g. N= 960.

NOTES