Evaluation of Flavors in Meat by the Use of Aqueous Extracts[a]

1301

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AQUEOUS EXTRACTS of poultry have been used in flavor studies by Bouthilet *(1, 2, 3)* and by Pippen *et al. (9)*. Grau *(6)* has shown that the higher the drying temperature, the greater is the loss of water soluble nitrogen compounds from beef and the more strawlike the flavor. He showed that the loss was not due to volatile compounds but to the conversion of water soluble materials to insoluble compounds. In 1948 Crocker *(5)* reported that a combination of pounding and squeezing in a hydraulic press, followed by three or more leachings of an hour each in water, was the best method, among several tried, for extracting flavor from beef, pork, and poultry. The materials thus obtained were subjected to the "critical, personal judgment of several workers for evaluation." To the best of our knowledge, extensive use has not been made of aqueous extracts in studies of meat flavor. Moreover, use of liquid extracts for tasting eliminates the distracting effects of texture, tenderness, and juiciness. We have found it well adapted to our needs in evaluating flavor production by a single bacterial species in experimental ham curing under completely controlled conditions *(8)*. Details will be given for the methods by which a taste panel was selected with aqueous extracts of meat, rather than meat, being used as the test material.

Aqueous extracts, so-called because water was added to the meat to be extracted, were used. Since the meat under study, cured ham, from one experiment to another contained varying amounts of free and bound ions, the extractions actually took place in salt solutions of gradually increasing concentration. Completeness of the salt extraction, or the role of concentration, if any, in removal of meat flavor was not determined.

The performance of the panel in judging similar mixtures of bouillon and meat indicated that, in respect to the problems presented by this particular investigation, bouillon prepared from aqueous extracts of ground meat was superior to cakes of meat as a material for the basis of taste testing.

MATERIALS AND METHODS

The panel was selected to evaluate the results of experiments designed to alter ham flavor during the curing process. Therefore, sensitivity to ham flavors was a requisite for panel members and dictated the general nature of materials to be used for testing in the panel selection. Two extremes in flavor, Smithfield-type cured ham and mild, rapidly cured, commercial ham were chosen, representing two widely different methods of curing. In actuality, lean meat from shoulders, subjected to a long curing period (the type used to produce old-fashioned country-cured ham) was used to obtain the Smithfield-type ham flavor. The aged shoulders were boned and the skin as well as rusty, hard, outer portions and practically all fat discarded. The meat was quite hard, hence it was chopped to the consistency of fine sawdust in the rotary blade and bowl attachment of a food cutting machine.[b] The mildly cured hams were boned, the skin and most of the fat were discarded, and the lean meat was passed twice through the ¼-inch plate of the sausage grinding attachment of the food cutting machine.[b] Ground meat, in each case, was placed in distilled water, 460 g./l., and left in the cold room at 5° C. for 48 hours. Total chloride determinations expressed as grams of sodium chloride were made on each batch of ground meat each time an experiment was run, and enough sodium chloride was added to the mildly cured meat (always the lowest in salt concentration) at the beginning of the extraction period to bring it to a salt concentration equal to that of the aged shoulder meat.

For convenience, the extractions were carried out in large beakers, which were covered tightly with aluminum foil and agitated 2 or 3 times each day. At the end of the extraction period, the ground meat was removed by filtering through a double layer of gauze. The filtrate only was saved for tasting. Some of the characteristic aged ham flavor remained in the discarded meat, based upon the opinion of experimenters who tasted cooked portions of it, but the greater part of the flavor was in the filtrate at this point. The filtrate was placed in a Florence flask, diluted with an equal volume of distilled water, and held in a boiling water bath with shaking for 15 min. During this time a practically tasteless coagulum formed from which the filtrate was decanted after standing at 5° C. overnight. Mixtures of the two 2X-diluted extracts were made such that four concentrations in respect to the 2X-diluted aged ham extract were available in two different sets of diluations (Table 1). Mixtures numbered 1, 2, 3, and 4 constituted the series used in panel selection, and those numbered 5–8, inclusively, constituted the series used in comparing meat and meat extract (Table 3). The latter series, in which the 50-50 mixture of aged and mild ham appears (No. 8), was necessary for direct comparison of meat and meat extract in organoleptic testing of flavor. A meat cake containing more than 50% of ground, aged ham would not stick together. Furthermore, a meat cake containing any more aged ham would have been readily detectable because of the great difference in texture and appearance between it and the others. This limitation in possible spread between various mixtures for ranking (standard method of panel selection regardless of flavor or material) and likewise the rather intense saltiness (5–7%) of meat mixtures containing as much as 50% aged or Smithfield-type ham were

[a] Presented at the Eighteenth Annual Meeting of the Institute of Food Technologists, Chicago, May 26, 1958.

[b] Hobart Food Cutter—Hobart Manufacturing Company, Troy, Ohio. The mention of specific trade names does not constitute endorsement of the product used over comparable equipment.

TABLE 1

Composition of mixtures of meat extract

Number	2X diluted extracts	
	Mild	Aged
Series 1	%	%
1	100	0
2	67	33
3	33	67
4	0	100
Series 2		
5	100	0
6	83.3	16.7
7	66.6	33.4
8	50.0	50.0

two factors inherent in using meat mixtures for panel selection. It was largely to overcome these disadvantages inherent in ham mixtures that we undertook to explore the possibility of using aqueous extracts. With these it was possible to secure high concentrations of the flavor constituents of cured ham. The concentration of flavor constituents was such as to allow dilution of salt to a palatable level (approximately 2% NaCl) while still retaining an extract of distinctly characteristic taste. The mixtures of meat extract were distributed in serological test tubes in 7 ml. quantities. The tubes were heated in a boiling water bath until the bouillon reached 60° C. Then they were each wrapped in white paper, coded, and served to potential panel members.

Each panel member received one of each of the 4 solutions and was asked to arrange them in order according to the content of aged ham flavor. Tubes of bouillon were served in bacteriological culture tube racks and were delivered to the desks of workers who served as taste testers. A paper cup of tap water was served with each rack. Some tasters took a sip of water between tubes of bouillon and some did not. An effort was made to serve the bouillon hot and at a worker's convenience, otherwise no consideration was given to time of day, smokers or non-smokers, or to the provision of aesthetic surroundings. Eighty clerical and technical workers who were willing to cooperate were screened for their ability to properly rank the four unknowns.

Meat cakes used in the experiment recorded in Table 3 were prepared with every possible effort to secure thorough mixing of meat and added salt. Mildly cured ham and aged shoulder were finely ground, chopped, and mixed in the proportions indicated in Table 2. Sodium chloride was added to make all batches equal in chloride content. In mixing, the ingredients of each batch were rotated and chopped together in the rotary meat cutter used for cutting the aged shoulder meat in the first place and were later mixed in a Waring blender. The cakes were cooked by boiling for 15 min. in enough water to cover them when placed flat on the bottom of a kettle with a tight fitting lid. At the end of the boiling period, the lid was removed and the water evaporated just to dryness. This was done carefully at low heat to avoid scorching the meat or depositing noticeable amounts of dissolved solids on the bottom of the pan. Meat cakes were served cold (as aged ham usually is served) and at the desks of workers in order to make results comparable to those obtained with extracts.

TABLE 2

Composition of mixtures of meat cakes

Number	Mixtures	
	Mild	Aged
	%	%
1	100	0
2	83.3	16.7
3	66.6	33.4
4	50.0	50.0

TABLE 3

Performance of panel
Ranking four mixtures of aqueous meat extracts and meats

Material tasted	Number of tasters					
	Total	Correct		Incorrect		Level of significance[1]
		Number	Percentage	Number	Percentage	
Meat extract						
Series 1	24	16	66.+	8	33.+	.001
Series 2	20	10	50.0	10	50.0	.050
Meat	26	5	19.2	21	80.7	

[1] Determined by the Chi Square Test of significance when values for meat and meat extract were compared.

The original chloride (assumed to be sodium chloride) concentrations of the seven different lots of aged meat prepared in this series of experiments ranged from 5.04 to 10.45%. The salt concentrations of the mildly cured commercial hams ranged from 3.62 to 3.93%. The chloride determinations were by the method of Kerr *(7)*. The wide variation in salt concentrations was largely the result of two factors; the percentage salt used in curing the meat, and the shrinkage or drying out of the meat in aging at 70° F. The aging process had been in progress for from one year to 16 months. The shoulders were used in a series of experiments extending over 4 months. The highest salt concentration was found in the shoulder with the highest salt concentration of the original cure.

RESULTS AND DISCUSSION

In ranking the 4 mixtures of Series 1 or 2 (Table 1) in proper order, the probability that a judge could make a correct guess was 1 in 24. Therefore, this method of screening was considered an adequate way of selecting tasters with a high degree of sensitivity for the flavor under study. In the first experiment, 30 of the original 80 tasters ranked all 4 mixtures in correct order and were therefore separated from the others on this basis. Some good judges among the 80 may have been eliminated in this first round, as sensitive tasters are known to give less than perfect performance in repeated tests *(4, 7)*. As the result, therefore, of 3 experiments in which prospective panel members were asked to correctly rank the 4 unknown ham extracts, the following scores were obtained. On the day of the second experiment only 19 of the originally selected 30 judges were present. Of these, 12 people got a perfect score in ranking. On the day of the third experiment 28 of the original 30 judges were available and 19 of these correctly ranked the 4 unknown samples. Twenty-six judges were selected to form the panel as these people properly scored the unknowns twice out of 3 trials. Six of these 26 people scored perfectly 3 times out of three trials.

The selected panel served in the evaluation of flavor in experiments reported by McLean and Sulzbacher *(8)*. It is suggested that judges who have demonstrated the ability to detect a given flavor can function with the efficiency of a precision instrument in respect to that and related flavors *(8)*.[c] In Table 3, results show that a much more accurate evaluation of meat flavor was made by the panel when meat extract, rather than meat itself, was tasted. Likewise, extracts with the greater spread between flavor levels and the lower salt concentration possible at the highest dilution (Series 1), statistically, proved far superior to

[c] The authors give credit for this comparison to Dr. Morris D. Finkner.

the extracts of Series 2 as taste test material. The panel showed a 20 to 1 (level of significance 0.050) greater degree of discrimination in judging the meat extracts of Series 2 than in judging the comparable meat cakes. The extracts of Series 2 were directly comparable to the meat mixtures. The method in which extracts are used permits an easy and accurate preparation of various mixtures which may be brought to equal salinity. It also makes organoleptic testing for flavor possible on small experimental lots of meat. It seems likely that the immediate availability of flavor constituents in meat extracts may be a factor in the great sensitivity of taste-tests utilizing them. Grinding and extracting for 48 hours would undoubtedly remove from meat more of the water soluble constituents than could be released in the few seconds involved in chewing a bite of meat. The impact upon a subject's taste buds of extract from a given amount of ham would, therefore, probably be greater than when such an amount of ham were chewed in a single bite.

SUMMARY

The addition of water to ground cured ham has proved a satisfactory method of removing flavor from aged Smithfield-type cured shoulders and also from ham mildly cured by current commercial methods. Extracts of such meat were used in the selection of a panel to evaluate flavor production in experimental ham curing. The methods used are recommended for their practicability and high degree of sensitivity to differences in cured ham flavor. It is suggested that the methods would probably be adaptable to the study of other types of meat, if flavor alone were the quality to be evaluated.

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