EMULSION PRODUCT ACCEPTABILITY AS AFFECTED BY LEVELS OF BOAR PORK AND LEVELS OF FENNEL SPICE

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The use of the flesh from non-castrated male pigs in emulsion sausage items such as bologna is limited because of the presence of "boar or sex odor". The most promising suggestions for masking the undesirable odor in such products involves either diluting the extent of the problem by adding only a percentage of boar flesh to the recipe or by adding small quantities of fennel spice to the recipe. This project was designed to determine the limiting levels for boar flesh incorporation with and without the addition of levels of fennel spice. In addition, three subjective panel boar odor detection methods previously used with fresh pork were evaluated as to their reliability for determining boar odor in both hot and cold bologna products. These included the trained taste panel, the hot-iron technique, and the boiling water-flask method. Pork characterized as possessing strong boar odor was blended in pork bologna products at concentrations (levels) of 0, 25, 50, 75 and 100% of the meat block. Each processing level contained 0, 0.075 or 0.15% of fennel spice. Boar levels had a significant linear effect of decreasing acceptable bologna aroma and flavor scores and increasing boar odor and flavor scores. Increasing boar levels also had a significant linear effect on improving color and texture of bologna. Increasing levels of fennel spice improved bologna flavor by suppressing boar odor and flavor scores. In view of increasing boar flavor scores and decreased bologna acceptability associated with increased incorporation of boar flesh, a product containing no more than 50% boar flesh and fennel spice at a concentration of 0.15% was most desirable. Both the hot-iron method and the hot-water method for evaluation of boar odor in either hot or cold emulsion products containing spices proved to be less reliable than the trained taste panel.

ACCEPTABILITE DU PRODUIT EN EMULSION LORSQU'IL EST AFFECTE PAR LA PRESENCE DE VIANDE DE PORC MALE ET DE FENOUIL.

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L'utilisation de la viande de porcs mâles non-castrés pour la fabrication de saucisses telles que celles dites "bologna" est limitée en raison de la présence d'une odeur "animale ou sexuelle". Les suggestions les plus prometteuses pour éliminer cette odeur indésirable dans de tels produits sont celles qui proposent de diminuer l'étendue du problème soit en ajoutant seulement un certain pourcentage de viande de porc mâle au mélange, soit en ajoutant à ce même melange de petites quantités de fenouil. Cette étude a été faite pour déterminer le niveau-limite d'incorporation de viande de porc mâle avec ou sans l'addition d'une certaine quantité de fenouil. De plus, trois méthodes subjectives destinées à la détection de l'odeur animale, déja utilisées avec du porc frais, ont été evaluées pour leur efficacité à déterminer l'odeur animale dans des produits dits "bologna" chauds et froids. Elles ont inclu une évaluation gustative, la technique du fer chaud ainsi que la méthode du flacon rempli d'eau bouillante. Du porc dégageant une forte odeur animale a été mélangé à des produits "bologna" à des concentrations de 0%, 0,25%, 50%, 75% et 100%. Chaque niveau de concentration a été traité avec 0%, 0,075%, ou 0,15% de fenouil. Le pourcentage de porc mâle a diminué d'une manière linéaire et très significative l'arôme de la saucisse "bologna". L'apport progressif de viande de porc mâle a amélioré d'une manière significative la couleur et la texture. L'addition de fenouil a amélioré le goût en éliminant l'odeur animale. Afin d'augmenter le goût animal et de diminuer le niveau d'acceptabilité de la saucisse, associé à l'incorporation progressive de viande de porc mâle, un produit contenant pas plus de 50% de viande de porc mâle et de fenouil a une concentration de 0,15% a été nécessaire. Pour l'evaluation de l'odeur animale dans des émulsions chaudes ou froides, les méthodes du fer chaud et de l'eau chaude se sont affirmées être moins efficaces que la méthode d'estimation gustative.

ANNEHMBARKEIT EINES EMULSIONSPRODUKTES UNTER EINFLUß VON MÄNNLICHEN SCHWEINEFLEISCH- SOWIE FENCHELANTEILE

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Der Gebrauch des Fleisches von nicht kastrierten männlichen Schweinen in emulgierten Wurstzusammensetzungen wie Bologna-Wurst ist wegen der Anwesenheit eines "männlichen Geschlechtsgeruches" begrenzt. Die am meisten versprechenden Vorschläge zur Maskierung des unerwünschten Geruchs sind, das Problem durch den nur teilweisen Gebrauch des männlichen Fleisches im Rezept sowie den Zusatz von kleinen Mengen Fenchel zu vermindern. Dieses Projekt will die Grenzen für den Zusatz von männlichem Schweinefleisch mit und ohne Zusatz von verschiedenen Fenchelmengen festlegen. Zusätzlich wurden drei subjektiv orientierte Prüfungsmethoden, die schon mit frischem Schweinefleisch gebraucht wurden, zur Feststellung des männlichen Fleischgeruches bei heißen und kalten Bologna-Würsten angewandt und auf ihre Verläßlichkeit untersucht. Sie waren: der ausgebildete Geschmacksprüfungsausschuß, sowie der Gebrauch eines heißen Bügeleisens und das Eintauchen in siedendes Wasser. Schweinefleisch mit starkem charkteristischen Geschlechtsgeruch wurde im Anteil von 0, 25, 50, 75 und 100% der Fleischmasse mit Bologna-Wurst aus Schweinefleisch vermengt. Bei jedem Anteilsgrad wurde ein Zusatz von 0, 0,075 und 0,15% Fenchel hinzugefügt. Männliche Fleischanteile bewirkten einen bedeutenden linearen Verminderungseffekt auf annehmbarem Bolognawurst-Geruch und -geschmack, und einen Vergrößerungseffekt auf männlichem Fleischgeruch und -geschmack. Zunehmdende männliche Fleischanteile bewirkten auch einen bedeutenden linearen Verbesserungseffekt in der Farbe und Beschaffenehit der Bologna-Wurst. Zunehmende Fenchel-Anteile verbesserten den Bolognawurst-Geschmack durch Unterdrückung der Geruchs- und Geschmacksnoten des männlichen Fleisches. In Hinsicht auf die zunehmenden männlichen Fleischgeschmacksnoten und die abnehmende Annehmbarkeit der Wurst mit zunehmendem männlichen Fleischanteil war ein Erzeugnis mit nicht mehr als 50% männliches Schweinefleisch und einer Fenchelkonzentration von 0,15% das annehmbarste Resultat. Die Prüfungsmethoden des heißen Bügeleisens und des siedenden Wassers zur Untersuchung des männlichen Fleischgeruchs in heißen und kalten Emulsionsprodukten erwiesen sich als weniger zuverlässig als der ausgebildete Geschmacksprüfungsausschuß.

ПРИЕМЛЕМОСТЬ ПРЕВРАЩЕННОГО В ЭМУЛЬСИЮ ПРОДУКТА В ЗАВИСИМОСТИ ОТ УРОВНЕЙ СОДЕРЖАНИЯ КАБАНЬЕГО МЯСА И ФЕНХЕЛЯ

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Употребление мяса некастрированных свиней мужского пола в таких эмульсированных колбасных продуктах как болонская колбаса ограничивается из-за присутствия "кабаньего или полового запаха." Самые обещающие предложения для устранения этого нежелательного запаха в таких продуктах связаны с включением в рецепт или только некоторой части кабаньего мяса или фенхеля. Целью этого исследования было определение лимитов включения кабаньего мяса с добавлением фенхеля и без него. Кроме того, была проверена надежность трех субъективных, уже применявшихся к свежей свинине для определения кабаньего запаха в холодных и горячих продуктах болонской колбасы. Эти три метода были следующие: комиссия из тренированных дегустаторов; проба при помощи раскаленного прута; помещение в колбу с кипящей водой. Свинина с сильным кабаньим запахом подмешивалась в продукты болонской колбасы в пропорциях 0, 25, 50, 75 и 100% всего мяса. При обработке всех уровней содержания кабаньего мяса содержание фенхеля было 0, 0,075, или 0,15%. Уровень содержания кабаньего мяса существенно понижал приемлемость запаха и вкуса болонской колбасы и существенно повышал кабаний запах и вкус. Повышение уровня кабаньего мяса существенно улучшало цвет и свойства ткани болонской колбасы. Повышение уровня содержания фенхеля, устраняя кабаний запах и вкус, улучшало вкус болонской колбасы. В связи с увеличением кабаньего запаха и понижением приемлемости болонской колбасы от включения большего количества кабаньего мяса, было установлено, что продукт, содержащий не более 50% кабаньего мяса и концентрацию фенхеля в 0,15% является наиболее желательным. Также было установлено, что метод пробы раскаленным прутом и колбы с кипящей водой являются менее надежными, чем тренированные дегустаторы для определения запаха кабаньего мяса в холодных или горячих продуктах, превращенных в эмульсию.

NITRITES AND NITROSAMINES IN PROCESSED MEATS

ARTICLE FOR XX EUROPEAN MEAT RESEARCH CONFERENCE (1974)

EMULSION PRODUCT ACCEPTABILITY AS AFFECTED BY LEVELS OF BOAR PORK AND LEVELS OF FENNEL SPICE

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INTRODUCTION

The flesh from intact male hogs (boars) has been characterized by many (Lerche, 1936; Plimpton, 1965; Plimpton and Teague, 1972; and Patterson, 1968a) as possessing a most offensive odor and flavor referred to as "boar odor", "sex odor" or "boar taint". Under United States Federal Inspection Regulations boar pork carcasses found to possess strong "boar odor" must be condemned. Admittedly, boar carcasses possessing less than strong boar odor are salvaged by many packers and used in sausage processing.

The success of such usage is mixed, but is usually based on the premise that mixing boar pork with barrow pork should dilute the problem. Fennel spice has been suggested as an effective agent to mask the problem.

Williams et al. (1963) reported that boar meat used in formulations of cooked salami and braunschweiger was quite acceptable to a trained taste panel. Likewise, Pearson et al. (1971) used boar pork in 22 processed pork items and reported that a consumer panel did not discriminate against those sausage items containing boar meat. Allen et al. (1973) concluded that boar meat can be used successfully in pepperoni without consumer dissatisfaction. Some U. S. packers experienced consumer complaints when boar tissue was used in sausage products. Differences in subjective methods used to detect the problem and differences in quantities of boar meat blended in the recipe could account for the apparent differences of opinion.

PROCEDURE

This project was designed to (1) determine levels at which boar pork could be added in bologna processing; (2) to ascertain the effectiveness of fennel spice in masking boar odor; and (3) to compare the practicality and reliability of three subjective methods for boar odor analysis in cold sausage items.

Boar pork used in this study was obtained from carcasses rated as possessing very strong boar odor, by: (1) the Taste Panel procedure described by Teague et al. (1964) and Plimpton, (1965); (2) the Hot Water Flask procedure outlined by Craig et al. (1962); and (3) the Hot Iron procedure discussed by Patterson and Stinson, (1971). Table 1 presents the boar odor data and percent of carcass trim fat for the pigs used in this study.

Table 1. LEAST SQUARES MEANS FOR BOAR ODOR AND FLAVOR[1] AND FOR % OF FAT TRIM OF CARCASSES SELECTED AS THE SOURCE OF PORK FOR THE BOLOGNA PROCESSING

	Boars			
	A	B	C	Barrow
Fat, %[2]	16.2	16.8	15.8	17.9
Boar Odor Score	7.5	8.0	9.0	2.0
Boar Flavor Score	7.5	7.5	8.5	1.0

[1]Taste panel procedure; 1 = no boar odor (flavor); 10 = very strong boar odor (flavor)

[2]Percent of trimmed carcass fat expressed on a chilled carcass basis

The panel members used in the bologna study were selected based on their performance in scoring boar odor in fresh pork by each of the three aforementioned methods. The analysis of variance (Harvey, 1968) performed on the data obtained from fresh sample evaluations indicated no significant ($P>.05$) differences between panel members for boar odor scores within or between the three methods of detection. The panel standard error for boar odor was 0.21 when samples were scored on a 1-10 basis. Repeatability tests showed that no panel member significantly differed from his original when served duplicate samples.

RESULTS

Boar Level

The effects of boar pork incorporation level on several attributes of the bologna are summarized in Table 2.

Table 2. LEAST SQUARES MEANS AND STANDARD ERRORS FOR PANEL EVALUATION OF BOLOGNA PRODUCTS AS INFLUENCED BY BOAR LEVEL

Evaluation method	Boar Level, % Means					Standard Error
	0	25	50	75	100	
Taste panel						
Bologna odor[1,3]	6.10	6.03	5.83	5.56	5.40	0.10
Bologna flavor[1,3]	5.92	5.69	5.73	5.23	5.18	0.11
Boar odor[2,3]	2.80	2.76	2.93	3.17	3.41	0.12
Boar flavor[2,3]	2.90	3.61	3.57	4.14	4.13	0.17
Gen. acceptability odor, flavor[1,4]	5.72	5.46	5.42	5.02	4.85	0.11
Hot iron odor[2,5]	2.65	3.50	4.38	3.20	3.90	0.27
Hot water odor[2]	3.14	3.91	4.08	3.50	3.94	0.27
Color[1,4]	6.03	6.02	6.28	6.26	6.28	0.08
Texture[1,4]	6.92	7.06	7.22	7.22	7.19	0.08

[1]Scoring system: 1 = unacceptable; 10 = acceptable

[2]Scoring system: 1 = no boar odor, flavor; 10 = very strong boar flavor

[3]Linear effect of boar level significant ($P<.01$)

[4]Linear effect of boar level significant ($P<.05$)

[5]Linear, cubic, quadratic effects of boar level significant ($P<.05$)

A significant ($P<.01$) linear increase in both boar odor and flavor was associated with increased levels of boar pork in bologna products when evaluated by the taste panel. The bologna odor and flavor scores and overall product acceptability decreased ($P<.01$) with increasing levels of boar pork in the formulation. The correlation between boar flavor and bologna general acceptability was $r=-0.71$. The repeatability of panel scores was quite reliable. However, greater difficulty was encountered by panel members in distinguishing between boar and barrow bologna products than between samples of fresh boar and barrow pork.

The boar and barrow pork to be used in this study was standardized to approximately the same fat content (30%) and bologna products were formulated to contain 0, 25, 50, 75 and 100% boar pork (as a percent of the meat block). Within each of these formulations fennel spice was added as part of the standardized spice mix at concentrations of 0, 0.075 and 0.15% of the meat block. Preliminary studies had suggested that these levels might be effective in masking boar odor. The experiment was replicated three times as summarized in Figure 1.

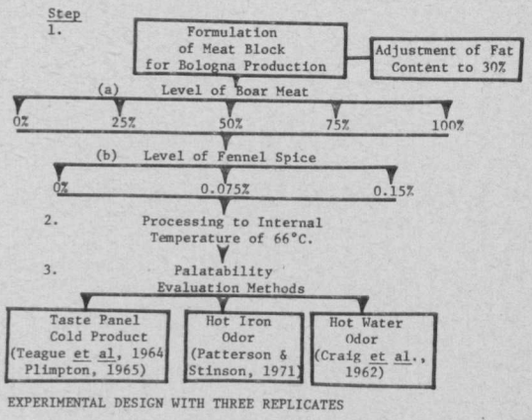

Figure 1. EXPERIMENTAL DESIGN WITH THREE REPLICATES

All bologna products were chopped and emulsified at 3500 RPM for 5 minutes in a Hobart Model VCM-15-3 two speed chopper. The products were stuffed into 9 cm casings with an E-Z Pak stuffer. The equipment was washed between the processing of each percentage level of boar meat and fennel spice. Bologna products were removed from the smokehouse after an internal temperature of 66°C had been reached. Products were chilled for 24 hours at 2°C and duplicate 4.25 mm slices were evaluated hedonically by a six member trained panel (Teague et al., 1964; Plimpton, 1965) for color, texture, bologna odor, boar odor, bologna flavor, boar flavor and acceptability of odor and flavor.

The bologna products (1.9 cm slices) were evaluated by the same panel using the hot iron method described by Patterson and Stinson (1971). In this procedure an Ungar #6939 electric desolderer equipped with an Ungar #6948 nickle-plated tip capable of reaching 287°C was touched to the duplicate bologna samples for 1-5 seconds and the resulting volatilized odor was rated hedonically from 1 (no boar odor) to 10 (very strong boar odor).

Subsequently, the same panelists rated duplicate 12 gm diced bologna samples using the hot water flask procedure outlined by Craig et al. (1962). Samples were placed in 500 ml flasks containing 250 ml of boiling water and the flasks were capped. After 1.5 minutes the flasks were presented to the panel members for evaluation of the steam for the presence of boar odor.

Evaluation of bologna for boar odor and flavor using the hot iron method and the hot water flask method yielded much larger standard errors. The size of the standard errors for these methods and the erratic nature of the results might be due to the methods volatilizing spices and thus confounding the panel members olefactory senses. The hot iron method would be useful in distinguishing boar bologna from barrow bologna, but would not be useful in eliciting graduated differences. The hot water flask method was not consistently effective in distinguishing boar bologna from all barrow pork bologna.

While the effect of boar level on odor and flavor attributes of bologna was linear when evaluated by a trained taste panel, the total scores for boar odor and boar flavor were relatively low if compared with the odor and flavor scores for the fresh boar pork used in these studies. Thus, the reduction in general acceptability might be considered to be minimal from a practical standpoint. The boar odor scores at the 25% and 50% incorporation levels were below the score (four) suggested by Patterson and Stinson (1971) to be objectionable to consumers.

The incorporation of boar meat into bologna formulations did result in a significant linear improvement in bologna color and texture as shown in table 2, but the differences were too small to be of practical value.

Fennel Spice Level

Addition of fennel spice at levels of 0.075% and 0.15% of the meat block improved bologna flavor and effectively reduced boar odor and flavor scores. These data are presented in Table 3.

Table 3. LEAST SQUARES MEANS AND STANDARD ERRORS FOR BOLOGNA PALATABILITY AS INFLUENCED BY LEVEL OF FENNEL SPICE

Evaluation method	Fennel level, % Means			Standard Error
	0	0.075	0.15	
Taste Panel Method				
Bologna odor[1]	5.88	5.73	5.75	0.08
Bologna flavor[1,3]	5.39	5.55	5.71	0.08
Boar odor[2,3]	3.27	3.01	2.77	0.09
Boar flavor[2,3]	4.14	3.76	3.11	0.13
Gen. acceptability odor and flavor[2,3]	5.17	5.18	5.53	0.08
Hot iron boar odor[2]	3.74	3.48	3.35	0.20
Hot water flask boar odor[2]	3.75	3.78	3.62	0.20

[1]Scoring system: 1 = unacceptable; 10 = acceptable

[2]Scoring system: 1 = no boar odor, flavor; 10 = very strong boar odor, flavor

[3]Linear effects of fennel level significant ($P<.01$)

The fennel levels used in this study had no significant effect on bologna aroma but the acceptability of bologna containing boar pork was enhanced due to the suppression of the boar odor and flavor.

Taste panel validity was again checked and no significant panel member differences nor loss of repeatability of scoring was noted. There were no significant panel member fennel spice level interactions, indicating that panel members did not react differently in their scoring ability in the presence of fennel spice.

Panel members had difficulties in scoring bologna containing fennel spice when using both the hot iron method and the hot water flask method. However, no significant ($P>.05$) differences in average panel scores due to fennel level were found. Differences due to panel-member fennel level interaction were also not significant ($P>.05$). These last two determinations indicate that fennel spice presented no greater problem for the panel members when using the hot iron and hot water flask methods than already encountered. The previously mentioned size of standard errors and inconsistent results obtained with these methods must be largely due to the general spices in the bologna recipe.

Boar Level X Fennel Spice Level

Boar flavor scores in the bologna products as influenced by boar level and fennel spice level are presented in Table 4.

Table 4. LEAST SQUARES MEANS AND STANDARD ERRORS OF BOAR FLAVOR[1] AS INFLUENCED BY BOAR LEVEL AND FENNEL LEVEL[2] IN COLD BOLOGNA USING THE TASTE PANEL EVALUATION METHOD

Boar level %	Fennel level %			Standard Error
	0	0.075	0.15	
0	2.81	3.06	2.81	0.28
25	4.16	3.81	2.87	0.29
50	4.16	3.31	3.21	0.29
75	5.08	4.41	2.91	0.29
100	4.45	4.18	3.75	0.31

[1] Scoring system: 1 = no boar flavor; 10 = very strong boar flavor

[2] Interaction significant ($P<.05$)

It is interesting to note that fennel spice did not adversely affect the acceptability of bologna products made without boar meat, although this fennel spice alone has a flavor similar to licorice,

The effectiveness of boar level and fennel spice level would be of interest in establishing a practical production combination. The analysis of variance did not yield significant interaction between boar pork level and fennel spice level for the taste panel evaluation of boar odor, bologna flavor nor general acceptability, indicating that boar level and fennel spice level performed in a similar manner in reducing boar odor and flavor and enhancing bologna acceptability.

There was a significant interaction between fennel spice level and boar level for taste panel evaluation of boar flavor, but it was merely the result of fennel spice having no effect on boar flavor scores in those bologna products containing no boar pork.

Conclusions

Both the dilution principle involving level of boar pork used in bologna products, and the addition of fennel spice were effective methods for the control of boar flavor leading to an improvement in boar bologna product acceptability. Taste panel evaluation seemed to yield the most consistent and reliable results for evaluating this effectiveness.

To recommend a combination of fennel spice level and boar pork level for satisfactory use in bologna processing, satisfactory bologna aroma and flavor scores and reduced boar flavor scores are important. It can be suggested that use of fennel spice at a level of 0.15 percent of the meat block in products containing no more than 50 percent boar pork would result in a satisfactory product.

BIBLIOGRAPHY

Craig, H. B., A. M. Pearson and N. B. Webb. 1962. Fractionation of components responsible for sex odor/flavor. J. Food Sci. 27:29.

Harvey, W. R. 1968. Least squares analysis of data with unequal subclass numbers. Agri. Res. Serv. 20-9 USDA.

Lerche. 1936. Geschlectsgeruch bei eberkastraten Zeitschrift fur Fleisch-und michhygiene. 46:417.

Patterson, R. L. S. 1968a. 5α-androst-16-ene-3-one: compound responsible for taint in boar fat. J. Sci. Fd. Agr. 19:31.

Patterson, R. L. S. and C. G. Stinson. 1971. A technique for the rapid estimation of 5α-androst-16-ene-3-one (boar taint) in pork carcasses. 17th Meeting, European Meat Res. Workers. Langford, Bristol, U. K.

Pearson, A. M., S. Ngoody, J. F. Price and H. E. Larzelere. 1971. Panel acceptability of products containing boar meat. J. Anim. Sci. 33:1 pg 24.

Plimpton, R. F. Jr. 1965. DES implantation of male swine; effect during extended growth on carcass composition, muscle quality and palatability. PhD dissertation. The Ohio State University, Columbus, Ohio.

Plimpton, R. F. Jr. and H. S. Teague. 1972. Influence of sex and hormone treatment on performance and carcass composition of swine. J. Anim. Sci. 35:6 pg 1166-1175.

Teague, H. S., R. F. Plimpton, Jr. V. R. Cahill, A. P. Grifo and L. E. Kunkle. 1964. Influence of diethylstilbestrol implantation on growth and carcass characteristics of boars. J. Anim. Sci. 23:332.

Williams, L. D., A. M. Pearson and N. B. Webb. 1963. Incidence of sex odor in boars, sows, barrows, gilts. J. Anim. Sci. 22:166.