tion, feed utilization and intake, shell percentage and body weight gain, while 0.40% ASA allowed values near control levels.

Microbiological counts or sensitivity tests on isolates from cecal contents of hens in Experiment 2 revealed no antimicrobial or antiseptic properties attributable to the levels of drug employed.

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The Relationship Between Collagen Content and Emulsifying Capacity of Poultry Meat

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INTRODUCTION

IT has been well established that a sausage batter or mix constitutes a form of an emulsion. Hansen (1960) and Swift *et al.* (1961) have established that fat incorporated into a sausage product is dispersed in small drops and enveloped with a layer of protein material, producing essentially an oil-in-water emulsion. Since sausage making traditionally has been an art and manufacturing procedures have been developed on an empirical basis, the knowledge and processes of emulsions and excellent quality sausages are important. Swift *et al.* (1961) have shown that the factors affecting the ability of meat to emulsify fat in a saline system include the extent to which meat is comminuted, the proportion of saline phase, the rates of addition of fat and of mixing and temperature. Much work has been reported concerning red meats and their ability to emulsify fat. This study was initiated because poultry meat in new products, such as chicken franks, bologna, chicken chunk roll, and other convenience items, is finding its place in the food industry. The emulsifying capacities of individual parts and classes of poultry carcasses were studied and correlated with the collagen content as determined by hydroxyproline measurements.

EXPERIMENTAL

Meat parts consisted of breast, wing, thigh, drumstick, neck meat, neck skin, total skin, back, heart, gizzard, and total carcass of light fowl, heavy fowl, fryers, roasters, fryer turkeys, and mature turkeys. The birds were obtained from the Cornell University farm. Light fowl consisted of one strain of Single Comb White Leghorn hens which had been laying 15 months. Heavy fowl consisted of White Rock hens which had been laying 12

months. The fryers and roasters were straight-run Cornish × Rock, 8 and 12 weeks of age respectively. Fryer turkeys and mature turkeys were Empire White males, 15 and 24 weeks of age respectively.

The samples were taken from 10 carcasses, ground, and mixed thoroughly. A portion of each sample was analyzed for collagen content; the remainder of each sample was wrapped in aluminum foil, frozen, and stored in −26°C. freezer until used in the emulsions.

The collagen content of each sample was determined by a procedure similar to that of Woessner (1961) based on hydroxyproline measurements. A few modifications in the sample preparation were as follows: (1) freeze-dry the sample, (2) grind the dried sample through 40 mesh screen on a Wiley Mill, (3) defat first with acetone, then ether and once again with acetone, (4) dry in a vacuum oven at 55°C. at about 0.5–1.0 mm. of mercury. Reagents including the hydroxyproline standard, buffer, chloramine T solution, perchloric acid solution and the p-dimethylaminobenzaldehyde solution were prepared as presented by Woessner (1961).

The basic method for determining the emulsifying capacity of individual parts of each class of poultry was similar to that of Swift *et al.* (1961). The principal steps: (1) comminute 50 gm. of ground meat in 200 ml. of 1 M NaCl (0 − 4°C). for 2 minutes at approximately 15,000 r.p.m., (2) add 37.5 ml. of cold 1 M NaCl (0 − 4°C.) to 12.5 gm. of the resulting slurry and mix 5 seconds at about 8,000 r.p.m., (3) add 50 ml. of Wesson oil (25°C.) from a graduated cylinder to the dilute slurry, (4) cut and mix in an Osterizer at about 15,000 r.p.m. while adding oil at a rate of about 0.8 ml. per second from a buret through Tygon tubing into the stirred mixture. An ice pack was used to prevent excessive temperature buildups. An emulsion formed which persisted and then finally collapsed, the transition being marked by a gradual increase followed by a sudden decrease (collapse) in viscosity. Addition of oil was immediately terminated on observation of the abrupt transition. Occasionally, near the "end point" rigid emulsions formed that resisted mixing even though the above conditions were chosen to minimize this. In those instances, a short section of Tygon tubing was used to manually assist the mixing process. The temperature was recorded at the "end point" or breakdown of the emulsion so that the temperature could be held constant. The volume of oil (50 ml. plus the additional oil from the buret) just exceeded the emulsifying capacity of the meat sample and is reported as emulsifying capacity: ml. of oil emulsified per 2.5 gms. of meat.

RESULTS AND DISCUSSION

In the collagen analysis, the hydroxyproline value for each sample of meat was an indication of 14% by weight of the collagen content on a freeze-dried fat-extracted basis. Each hydroxyproline value was then converted to a fresh meat basis and the collagen content was calculated and expressed as gms. of collagen per 2.5 gms. of meat. The emulsifying capacity was already expressed as ml. of oil emulsified per 2.5 gms. of meat.

The correlation coefficients of emulsifying capacity on collagen content for all of the parts were determined on each class of poultry; in each case the emulsifying capacity was the dependent variable and the collagen content was the independent variable. The equations of the regression lines of individual parts were determined by the least squares method for each class of poultry (Fig. 1).

An analysis of variance of the regression of oil emulsified on collagen content showed a highly significant F value for

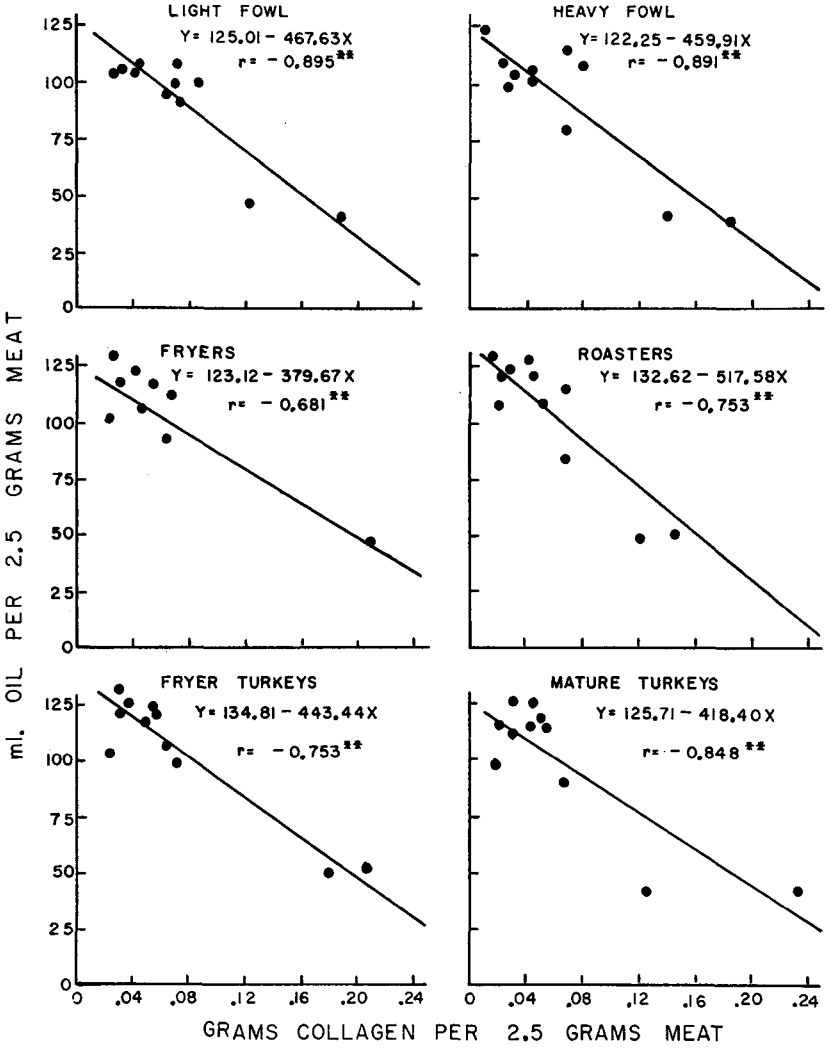

FIG. 1. Effect of collagen content on emulsifying capacity of the 11 parts for each class of poultry. Collagen content is plotted as the independent variable on the abscissa and emulsifying capacity is plotted as the dependent variable on the ordinate. The dots represent the intersections of the observed collagen content and emulsifying capacity for each of the 11 parts of the particular class of poultry. The least squares method was used to calculate the linear regression line which most nearly fits the plotted data.

each correlation. The significant correlations are largely due to the amount of skin in each part.

The emulsifying capacities of individual parts of each class of poultry were ranked according to their ability to emulsify fat starting with the part that had the greatest emulsifying ability. Collagen content of individual parts, with a few exceptions, followed an inverse ranking order when compared with emulsifying capacity, thus supporting the negative correlation coefficients.

TABLE 1.—*Emulsifying capacity and collagen content of the 11 individual parts averaged over all 6 classes of poultry*

Part	Oil emulsified ml./2.5 gm. meat	Collagen g./2.5 gm. meat
Breast	120.3	0.023
Thigh	115.0	0.034
Back	114.4	0.032
Drumstick	112.6	0.059
Wing	112.1	0.050
Total carcass	111.0	0.066
Neck meat	106.9	0.058
Heart	99.8	0.024
Gizzard	87.4	0.070
Neck skin	46.2	0.139
Total skin	42.6	0.196

All 6 classes of poultry were grouped and the means for the individual parts were compared (Table 1).

A 6 × 11 factorial experiment with two replications and 131 degrees of freedom showed a significant interaction between individual parts and classes of meat. Therefore, Duncan's new multiple range procedure was used to check for significant differences by testing the part means for each class. In all cases, total skin, neck skin and gizzard emulsified significantly less oil than breast, thigh and back meat at the 5% level. Also, total skin and neck skin emulsified significantly less oil than gizzard. Breast meat generally emulsified the most oil; thigh, back, drumstick, wing, total carcass and neck meat with small inconsistent observable differences emulsified similar amounts of oil.

TABLE 2.—*Emulsifying capacity and collagen content of total carcass for each class of poultry*

Class	Oil emulsified ml./2.5 gm. meat	Collagen g./2.5 gm. meat
Light Fowl	96.6	0.073
Heavy Fowl	106.2	0.080
Fryers	109.2	0.067
Roasters	114.8	0.070
Fryer Turkeys	121.8	0.056
Mature Turkeys	117.3	0.052

LF HF F R MT FT

* Any two means underscored by the same line are not significantly different.

To find out which class of poultry produced the best emulsion products, each individual part was evaluated over the six classes of poultry. No significant differences were obtained which held for all 11 parts. Therefore, Duncan's new multiple range procedure was used to check for significant differences among total carcass values for each class of poultry. Light fowl total carcass emulsified significantly less oil at the 5% level than any of the other classes of poultry (Table 2).

CONCLUSIONS

The method used in this study provides comparative estimates of the capacity of individual parts of different classes of poultry to emulsify fat. It has been found that the collagen content of poultry meat is a reliable estimator of emulsifying capacity when dealing with meat and skin mixtures. Collagen can be detrimental to the process of making poultry meat emulsions because of the inability of collagen to dissolve and form stabilizing membranes necessary for emulsion formation. In general, the voluntary muscle meats such as breast and thigh have a higher emulsifying capacity than the gizzard, heart or skin of poultry meat. Light fowl total carcass was found to emulsify significantly less oil than any other class of poultry. Research is now in progress to study the influence of salt-soluble proteins, fat, freezing and pH on poultry meat emulsions.

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The Effect of Pasteurizing Liquid Whole Egg on Viscosity, α-amylase and *Salmonella senftenburg*

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IT HAS been known for some time that several types of Salmonella, including *S. pullorum* and *S. gallinarum,* occur in chicken eggs. However, through an effective blood testing program, these poultry disease producing organisms have been nearly eliminated from present day flocks. Cantor and McFarlane (1948) indicated in their review of literature that well over 50 types of Salmonella have been isolated from spray-dried whole egg powder manufactured in the United States. Nine of the types found in egg powder, besides *S. pullorum,* have been isolated from shells of chicken eggs. Murdock *et al.* (1960) mentioned that however small the proportion of shell eggs contaminated with Salmonella, bulk liquid egg is likely to contain Salmonella. Hobbs (1962) feels that all egg products, whether liquid, frozen or dried whole eggs and wherever they originate, are contaminated with Salmonella.

Pasteurization of liquid whole egg has been studied by numerous workers and it seems that this heat treatment prior to the production of frozen whole egg, bulk liquid whole egg or dried whole egg offers a practical solution to the problem (Heller *et al.* 1951). Pasteurization serves several functions. It reduces the viable bacteria count, destroys possible pathogenic bacteria such as Salmonella and improves the keeping quality of the liquid whole egg (Miller and Winter, 1950). As a result of considerable research on the pasteurization of liquid whole egg the recommended times and temperatures vary from 60°C. for 3 minutes (Goresline *et al.,* 1951) to 64.4°C. for 2.5 minutes (Heller *et al.,* 1962; and Shrimpton *et al.,* 1962) to kill any Salmonella present without appreciably affecting the functional qualities of the egg product.

Heller *et al.* (1962) and Sugihara and Kline (1965) reported that when liquid egg has been subjected to homogenization pressures of 500 p.s.i. the viscosity of the liquid egg is reduced. This condition has been voiced by some commercial users of pasteurized liquid whole egg to be objectionable and they assume the product has