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EFFECT OF TEXTURED VEGETABLE PROTEIN
AND SKIN CONTENT ON COOKED TURKEY
ROLL

S. R. Drake, et al

Army Natick Laboratories
Natick, Massachusetts

August 1974

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TECHNICAL REPORT

75-17-FEL

EFFECT OF TEXTURED VEGETABLE PROTEIN
AND SKIN CONTENT ON COOKED TURKEY ROLL

By

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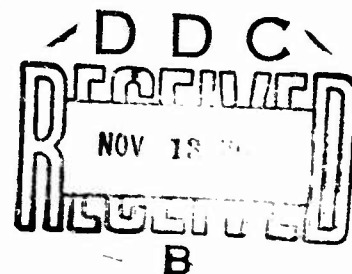
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ABSTRACT

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INTRODUCTION

Turkey is generally purchased, by the military, as a boneless turkey roll, except when major holidays are a consideration. These boneless turkey rolls, as purchased under Military Specification (MIL-T-1660D) have been in need of improvement, and work has been conducted, in recent months, to investigate methods to improve this product. Research has been conducted to investigate different additives as binding agents (1), to discern the effect of prolonged storage on texture, and other quality characteristics of boneless turkey rolls (5). This study was initiated ultimately to investigate the potential use of textured vegetable protein and ground turkey skin as extenders in boneless turkey rolls.

The use of textured vegetable protein to extend meat products has been investigated, but not widely accepted (4). Textured vegetable protein has a definite economic advantage and this economic advantage can make up for in part the disadvantages reported for this product. The skin of poultry has long been used as a covering in the manufacturing of boneless turkey rolls is required by (MIL-T-1660D), however, this has been found to be unsatisfactory. Incorporation of turkey skin into the meat roll has been suggested; if feasible, use of the turkey skin in this manner may lead to improvement, and reduce the cost of boneless turkey.

EXPERIMENTAL METHODS

A three by five factorial experimental design was devised in which three levels of skin (0, 6 and 12%) and five levels of textured vegetable protein (0, 5, 10, 15 and 20%) were incorporated into cooked boneless turkey rolls.

Frozen young tom turkeys (20-25 lbs) were obtained from a commercial source and were allowed to thaw over a 48-hour period in a refrigerator operating at 4.5°C. The skin was removed and the meat was boned by hand and diced into 5.00 cm cubes. The turkey skin was ground twice through a meat grinder, using a 0.32 cm plate. Textured vegetable protein (TVP), unflavored, size 190 was obtained from Archer Daniels Midland and Co. Values for the textured vegetable protein were calculated on a wet weight basis; moisture content of the hydrated form was 70% in all instances (6).

Fifteen treatment mixtures consisting of cubed turkey meat (light: dark, 60:40) ground skin, and textured vegetable protein were made on a weight/weight basis and mixed in a Hobart Mixer (Model N-50) for three minutes to insure thorough blending. A binding agent consisting of 0.5% sodium tripolyphosphate and 1.5% salt was added to each treatment at the start of the blending period.

After blending the product, 1.8 Kg was stuffed into 8.9 cm in diameter, cellulose meat casings and processed in hot water at 87°C until an internal temperature of 76°C was reached. Each roll was fabricated separately and in a random order. The turkey rolls were placed in a refrigerator operating at 4.5°C for holding until analysis. The analysis of each treatment required no longer than three days.

Sensory evaluation of color, odor, flavor, texture and appearance was conducted by using a panel of 15 Food Technologists following the procedures outlined by Larmond (2). Moisture was determined by placing the samples in a 70°C oven with 67.50 Pa of vacuum for 24 hours. Shear values were determined by using the Allo-Kramer shear press equipped with a CA-1 single blade shear cell and a 45.5 Kg force ring. Three millimeter thick slices of turkey were used in sensory evaluations and shear force determinations. Objective measurements for color were determined by using the Hunter Color Difference Meter with a white plate number 2165 as a standard. The average cooking loss was determined by weight difference.

The experiment was designed around accepted statistical methods (3) with three replications/treatment, and analysis of the data was accomplished by using the US Army Natick Laboratories Univac Model 1106 Computer.

The interacting effect of textured vegetable protein (TVP) and skin on the shear values determined for cooked turkey rolls, Table 1, was significant ($P < .99$), but these values showed no particular pattern trends. However, a slight trend towards lesser shear values as the amount of TVP and skin increased was evident but not conclusive. TVP alone had a significant ($P < .99$) effect on shear values and as the amount of TVP was increased the shear values decreased. This decreasing pattern as the amount of TVP was increased ranging from a high of 9.80 (kg of force) to a low of 8.14 (kg of force), but this pattern became very erratic beyond the incorporation of 15% TVP into the product. The increasing addition of skin into cooked turkey rolls also resulted in significantly ($P < .99$) decreasing shear values for the product (8.91 to 8.42).

The highest shear values determined for cooked turkey rolls was 9.94 (6% skin no TVP) and the lowest 7.29 (5% TVP no skin) with the difference being 2.65. This difference of 2.65 is not much greater than the standard deviation 2.06 determined for the grand mean. This difference between the highest and lowest shear values is slight, and the shear values determined for all treatment combinations can be considered very acceptable. In fact, all the shear values in Table 1, are superior to those shear values reported earlier (1 and 5) on cooked turkey rolls.

Color scores, as determined by the sensory panel, for cooked turkey rolls containing TVP and ground skin are presented in Table 2. TVP content had a significant ($P < .99$) effect on sensory panel color scores. As the amount of TVP was increased color scores decreased. Turkey rolls containing no TVP received the highest color score 6.62. Turkey rolls with 5 and 10% TVP received significantly similar scores (6.11 and 6.08) and rolls with 15 and 20% TVP received scores (5.71 and 5.64) that were not significantly different from each other. Beyond the addition of 5% TVP significant reductions in color scores may be expected for every 10% increase in TVP up to 20%.

Table I

Allo-Kramer shear values determined for cooked turkey rolls containing selected amounts of textured vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP
	0%	6%	12%	
0%	9.91 ^(2,3)	9.94	9.53	9.80 ^{a(1)} ± 2.30
5%	7.29	9.88	8.86	8.68 ^b ± 2.09
10%	9.48	8.19	7.59	8.42 ^{bc} ± 3.56
15%	9.20	7.59	7.62	8.14 ^c ± 1.62
20%	8.65	8.47	8.47	8.53 ^b ± 1.93
\bar{X} for effect of ground skin	8.91 ^{a(1)} ± 2.27	8.82 ^a ± 2.02	8.42 ± 1.85	\bar{X} 8.72 ± 2.06

1. Means of any column or row with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Kg of force required to shear a 3 mm slice.

3. Observations/treatment = 5.

Table 2

Sensory panel color scores for cooked turkey rolls containing selected amounts of texture vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP
	0%	6%	12%	
0%	6.82 ⁽²⁾	6.67	6.37	6.62 ^{a(1)} ±0.90
5%	6.48	5.95	5.89	6.11 ^b ±1.12
10%	6.24	6.02	5.97	6.08 ^b ±1.01
15%	5.89	5.86	5.38	5.71 ^c ±1.01
20%	5.60	5.66	5.68	5.64 ^c ±1.17
\bar{X} for effect of ground skin	6.21 ^{a(1)} ± 1.14	6.04 ^a ± 1.13	5.86 ^b ± 1.21	\bar{X} 6.04 ±1.17

1. Means of any column or row with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observation/treatment = 45

3. Color rated on a 1 to 9 score (9 = like extremely; 1 = dislike extremely).

Skin content also had a significant ($P < .99$) effect on sensory color values. As the amount of skin was increased color scores decreased, but a significant reduction in color scores did not occur until the addition of 12% ground skin (5.86 compared to 6.04 or 6.21). The interaction between skin and TVP was not significant.

All sensory color values determined in Table 2, were arbitrarily considered to be acceptable. The highest color value was 6.82 and the lowest 5.60 with a grand mean of 6.04. The lowest value 5.60 is equal to the mean values reported by Stadleman et. al. (5) and the value 6.04 is higher than the mean values reported by Drake et. al. (1) for sensory color scores determined in cooked turkey rolls.

Sensory scores for odor, Table 3, were significantly ($P < .99$) affected by the amount of TVP and skin incorporated into cooked turkey rolls. The interaction between skin and TVP was determined to be negligible.

As the amount of skin incorporated into turkey rolls increased sensory odor scores decreased, but these decreasing values indicated no definite demarcation. Turkey rolls containing no skin received the highest mean odor score 6.27, but this value is not significantly different from the value 6.12 determined for rolls with 6% skin, and the value 6.12 is not significantly different from the score 5.97 received for rolls with 12% skin.

Sensory odor scores decreased as the amount of TVP was increased, but this downward trend was erratic. Those rolls with no TVP received the highest odor score 6.36, but this value was not significantly different from the value 6.22 (5% TVP), and the value 6.22 was not different from the value 6.12 (20% TVP). Turkey rolls with 10 and 15% TVP received the lowest and similar odor scores 5.96 and 5.94. This erratic trend in odor scores is questionable, and if we consider the standard deviation present it is possible to assume that the values 5.96 and 5.94 are too low. Except for those rolls with 10 and 15% TVP all the values in Table 3, were superior to those odor values determined earlier for cooked turkey rolls, and all the values presented in this table are superior to the mean values determined by Stadleman et. al. (4). On the numbered scale used in this paper, it is well to note that the higher number the more desirable the odor.

The sensory panel indicated that the flavor scores, Table 4, for cooked turkey rolls were significantly ($P < .99$) related to the amount of TVP and skin incorporated into the product and a significant ($P < .95$) interaction existed between skin and TVP.

A treatment combination of 6% skin and no TVP received the best panel score 6.38, and the treatment 12% skin with 15% TVP received the worst panel score 4.89. Except for the values, 6.38, 5.17, 4.89 and 5.51 the mean panel score decreased as the amount of TVP and skin increased. The overall difference in these decreasing values was 1.49

Table 3

Sensory panel odor scores for cooked turkey rolls containing selected amounts of textured vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP
	0%	6%	12%	
0%	6.49 ⁽²⁾	6.38	6.22	6.36 ^{a(1)} ±1.04
5%	6.33	6.22	6.47	6.22 ^{ab} ±1.04
10%	6.11	5.98	5.80	5.96 ^c ±1.02
15%	6.28	5.93	5.62	5.94 ^c ±1.08
20%	6.15	6.11	6.09	6.12 ^b ±1.04
\bar{X} for effect of ground skin	6.27 ^{a(1)} ± 1.00	6.12 ^{ab} ± 1.01	5.97 ^b ± 1.13	\bar{X} 6.12 ±1.05

1. Means of any column or row with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observations/treatments = 45.

3. Odor rated on a 1 to 9 scale (9 = like extremely; 1 = dislike extremely).

Table 4

Sensory panel flavor scores for cooked turkey rolls containing selected amounts of textured vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP
	0%	6%	12%	
0%	6.06 ⁽²⁾	6.38	6.33	6.26 ^{a(1)} ±1.01
5%	6.31	5.82	5.60	5.91 ^b ±1.30
10%	5.73	5.17	5.42	5.44 ^c ±1.37
15%	5.69	5.65	4.89	5.41 ^c ±1.43
20%	5.31	5.51	5.31	5.38 ^c ±1.40
\bar{X} for effect of ground skin	5.82 ^{a(1)} ± 1.22	5.70 ^{a b} ± 1.35	5.51 ^b ± 1.47	\bar{X} 5.68 ±1.35

1. Means of any column or row with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observations/treatment = 45.

3. Flavor rated on a 1 to 9 scale: (9 - like extremely; 1 - dislikes extremely)

between the best and worst panel scores, and this value 1.49 is very similar to the standard deviation, 1.35, determined for the grand mean. Thus a distinct difference among treatments was hard to determine and all mean scores could be considered acceptable.

Flavor scores decreased as the amount of TVP increased. The best mean flavor score 6.26 for the treatment containing no TVP was significantly superior to the remaining flavor scores determined for turkey rolls with TVP. The addition of 10, 15, or 20% TVP resulted in no greater reduction of the mean flavor scores (5.44, 5.41 and 5.38). Increased skin content resulted in decreased flavor scores, and this reduction in flavor scores was significant between 0 and 12% skin 5.82 to 5.51. The addition of 6% skin resulted in a score 5.70 that was not significantly different from either the highest or lowest score.

All flavor scores presented in Table 4, compare favorably with the flavor scores reported for cooked turkey rolls, and only those rolls containing more than 12% skin and 15% TVP had flavor scores that were less than cooked turkey rolls manufactured according to Mil-Spec (MIL-T-1600) and reported earlier (1).

Mean sensory values for texture are presented in Table 5. Textured vegetable protein was found to have a highly significant ($P < .99$) effect on the texture of cooked turkey rolls. Skin content and the interaction between TVP and skin had no effect on the texture of turkey rolls.

Those rolls that contained no TVP received the highest mean panel score 6.40, and the rolls with 5 and 15% TVP received the lowest mean panel scores 5.96 and 5.99. Turkey rolls with 10 and 20% TVP had similar texture scores 6.16 and 6.25. Those rolls with the highest and lowest amounts of TVP received similar scores 6.25 and 6.40. Twenty percent TVP and 12% skin may be incorporated into cooked turkey rolls, and the resulting texture will not be effected to a significant extent.

All texture scores in Table 5, are superior to the texture scores reported by Drake et. al. (1) for cooked turkey rolls, and only those treatments, with the texture scores of 5.80, 5.73 and 5.80, had scores less than those scores reported earlier by Stadleman et. al. (5).

Sensory panel scores for appearance were significantly ($P < .99$) effected by the amounts of TVP and skin incorporated into turkey rolls. The interaction between skin and TVP was found to be negligible, Table 6.

Turkey rolls containing no TVP received the highest appearance mean value 6.50, and as the amount of TVP was increased the appearance scores decreased. The addition of 5% or more TVP resulted in a reduced panel score, but the incorporation of 20%

Table 5

Sensory panel texture scores for cooked turkey rolls containing selected amounts of textured vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP
	0%	6%	12%	
0%	6.48 ⁽²⁾	6.49	6.22	6.40 ^{a(1)} ±1.07
5%	6.35	5.80	5.73	5.96 ^d ±1.27
10%	6.31	6.04	6.13	6.16 ^{bc} ±1.09
15%	6.07	6.11	5.80	5.99 ^{cd} ±1.10
20%	6.11	6.26	6.34	6.25 ^{ab} ±1.06
\bar{X} for effect of ground skin	6.27 ± 1.11	6.14 ± 1.11	6.05 ± 1.16	\bar{X} 6.15 ±1.13

1. Means of any column with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observations/treatment = 45.

3. Texture rated on a 1 to 9 scale: (9 =like extremely; 1 = dislike extremely)

Table 6

Sensory panel appearance scores for cooked turkey rolls containing selected amounts of textured vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP
	0%	6%	12%	
0%	6.64 ⁽²⁾	6.57	6.31	6.51 ^{a(1)} ±0.92
5%	6.27	5.93	5.64	5.94 ^b ±1.17
10%	6.09	5.82	5.71	5.87 ^b ±1.14
15%	5.66	5.87	5.33	5.62 ^c ±1.29
20%	5.75	5.82	5.78	5.78 ^{bc} ±1.21
\bar{X} for effect of ground skin	6.08 ^{a(1)} ± 1.17	6.00 ^a ± 1.13	5.75 ^b ± 1.24	\bar{X} 5.95 ±1.19

1. Means of any column or row with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observations/treatment = 45.

3. Appearance rated on a 1 to 9 scale (9 = like extremely; 1 = dislike extremely)

TVP causes no more significant a reduction than does the incorporation of 5% TVP (5.94 compared to 5.78). Turkey skin up to 6% may be incorporated into turkey rolls with no subsequent loss in appearance values, but the addition of 12% skin resulted in a significantly reduced appearance score (5.75 compared to 6.00 or 6.08).

The appearance of a product has a large influence on consumer acceptability. In all treatment combinations the product when sliced, to a thickness of 3 mm at 4.5°C, remained intact with no internal voids and the product had a very acceptable appearance.

The appearance scores reported in Table 6, are greater than the appearance scores for cooked turkey rolls presented earlier by Stadleman et. al. (5) and only those treatments, with appearance scores less than 5.73, had appearance scores lower than those reported by Drake et. al. (1).

The Hunter Color "L" values are numerical evaluations between 0.00 for perfect black and 100.00 for perfect white. The amount of TVP and skin plus the interaction between skin and TVP was found to have a highly significant ($P < .99$) effect on Hunter Color "L" values determined for cooked turkey rolls - Table 7.

As the amount of TVP was increased a trend towards a darker product was established. This trend was not objectionable, but the difference was significant. The addition of 5, 10, and 15% produced mean scores 60.04, 60.31 and 60.34, that were significantly different than the mean score 62.28, for the treatments with no TVP, and 20% TVP resulted in a mean score 58.72 that was different than all other scores. The amount of skin incorporated into turkey rolls had a slight but significant effect on Hunter Color "L" values. As the amount of skin, up to 6%, was increased mean color scores increased 59.87 to 61.11, but when 12% skin was added to the turkey rolls mean color scores were reduced, 61.11 and 59.87 is only 1.24 color units and this difference is smaller than the standard deviation 2.73. Thus Hunter Color "L" differences due to skin content is questionable.

The Hunter Color "a" values determines the amount of redness of a product, e.g., the higher the number the more red the product. Mean values for Hunter Color "a" values are presented in Table 8. The amount of TVP present in cooked turkey rolls had a significant ($P < .99$) on Hunter Color "a" values. Skin and the interaction between skin and TVP was found to be non-significant.

Turkey rolls containing 20% TVP had the highest mean values determined for redness, but this value 3.84 was not significantly different from the mean value 3.75 determined for rolls with no TVP. Turkey rolls with 5, 10 or 15% TVP indicate a definite reduction in Hunter Color "a" scores, but no particular pattern was established and the standard deviation was large.

Table 7

Hunter Color "L" values determined for cooked turkey rolls containing selected amounts of textured vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP
	0%	6%	12%	
0%	62.45 ⁽²⁾	64.17	60.23	62.28 ^{a(1)} ± 4.27
5%	61.05	60.28	58.80	60.04 ^b ± 1.65
10%	58.04	61.52	61.37	60.31 ^b ± 2.36
15%	59.42	60.07	61.53	60.34 ^b ± 1.69
20%	58.20	59.52	58.27	58.72 ^c ± 1.41
\bar{X} for effect of ground skin	59.87 ^{a(1)} ± 2.99	61.11 ^b ± 2.77	60.04 ^c ± 2.25	\bar{X} 60.34 ± 2.73

1. Means of any column or row with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observations/treatment = 15.

Table 8

Hunter color "a" values determined for cooked turkey rolls containing selected amounts of textured vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP ±
	0%	6%	12%	
0%	4.02 ⁽²⁾	3.30	3.91	3.75 ^{a(1)} ± 1.81
5%	3.12	3.48	2.82	3.18 ^b ± 1.34
10%	3.14	2.92	2.58	2.88 ^b ± 1.44
15%	2.80	2.95	3.21	2.99 ^b ± 1.12
20%	3.52	3.74	4.26	3.84 ^a ± 1.23
\bar{X} for effect of ground skin ±	3.32 1.59	3.31 1.51	3.35 1.46	\bar{X} 3.33 ± 1.45

1. Means of any column with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observations/treatment = 15.

Hunter Color "b" values for yellowness – Table 9, were significantly ($P < .99$) effected by the amount of skin and TVP present, plus the interaction between skin and TVP had a significant ($P < .95$) effect on the yellow color of cooked turkey rolls.

As the amount of skin and TVP was increased more yellowness, or higher Hunter Color "b" values was evident. In fact, the treatment containing 12% skin and 20% TVP received the highest Hunter Color "b" value 15.43. As the amount of skin in turkey rolls increased the Hunter Color "b" values increased, but these mean values 13.63, 13.67 and 14.01 were not significantly different. Increased amounts of TVP in turkey rolls resulted in increased Hunter "b" values, and this proportional increase in yellow color was significant at all levels of TVP except between 15 and 20% TVP which had significantly similar Hunter "b" scores 14.57 and 14.94.

The increased yellowness for turkey rolls containing skin and TVP was also evident to the sensory panel – Table 2, but this increase in yellowness was deemed to be not objectionable.

Textured vegetable protein, skin and the interaction between TVP and skin had a significant effect ($P < .99$) on the moisture content of cooked turkey rolls – Table 10.

Increasing amounts of TVP and skin resulted in a decreasing moisture content for the product. When skin content is increased in amounts of 6%, a 2% moisture decrease is very evident, and these decreasing mean values 67.46, 65.52 and 63.54 were significantly different. Increased amounts of TVP also resulted in a corresponding decrease in moisture content of the product. The greatest decrease in moisture content was a result of the addition of 5% TVP from this point 65.66 moisture reduction was more gradual. All moisture values determined in Table 10, were acceptable.

Cooking loss in turkey rolls may be significantly reduced through the use of TVP, Table 11. As the amount of TVP is increased by increments of 5%, the average cooking loss on an 18 Kgm turkey roll was reduced to 20 gm. Reductions of cooking losses were significant ($P < .99$) at increments of 10% increases of TVP. The mean cooking loss for turkey rolls containing no TVP was 257 gm; whereas the loss for rolls with 10% TVP was 197 gm, a highly significant reduction in weight loss. By the same token turkey rolls with 15% TVP lost 175 gm which is a highly significant reduction in weight loss when compared to rolls with 5% TVP, 231 gm. The cooking loss of turkey rolls with 20% TVP, 156 gm, was not significantly different from those rolls with 10% TVP, 197 gm.

As cooking loss decreases with increasing amounts of TVP, it is suggested that turkey rolls should contain more moisture, but this was determined not to be the case, Table 10. As the amount of TVP increases there is a corresponding decrease in turkey meat found in the fabricated rolls.

Table 9

Hunter color "b" values determined for cooked turkey rolls containing selected amounts of textured vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP ±
	0%	6%	12%	
0%	12.27 ⁽²⁾	12.02	12.03	12.11 ^{d(1)} ± 1.45
5%	12.70	13.51	13.47	13.23 ^c ± 1.02
10%	13.91	13.69	14.43	14.01 ^b ± 1.15
15%	14.33	14.67	14.71	14.57 ^a ± 1.08
20%	14.95	14.44	15.43	14.94 ^a
\bar{X} for effect of ground skin ±	13.63 ^{a(1)} 1.67)	13.67 ^a ± 1.47	14.01 ^a ± 1.53	\bar{X} 13.77 ± 1.54

1. Means of any column or row with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observations/treatment = 15.

Table 10

Moisture values determined for cooked turkey rolls containing selected amounts of textured vegetable protein and ground skin

Amount TVP	Amount of ground skin			\bar{X} for effect of TVP \pm
	0%	6%	12%	
0%	69.25 ⁽²⁾	66.99	64.25	66.83 ^{a(1)} \pm 2.19
5%	68.48	75.74	62.74	65.66 ^b \pm 2.70
10%	67.46	65.31	63.93	65.57 ^b \pm 1.79
15%	66.33	65.29	63.65	65.09 ^{bc} \pm 2.02
20%	65.81	64.32	63.10	64.41 ^c \pm 1.78
\bar{X} for effect of ground skin \pm	67.46 ^{a(1)} 1.66	65.52 ^b 1.58	63.54 ^c 1.49	\bar{X} 65.51 \pm 2.25

1. Means of any column or row with the same letters are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observations/treatment = 30.

Table 11

Cooking losses (grams) determined for turkey rolls containing selected amounts of textured vegetable protein and ground skin cooked in 87°C water to an internal temperature of 76°C

Amount TVP	Amount of ground skin			X for effect of TVP
	0%	6%	12%	
0%	250 ⁽²⁾	258	263	257 ^{a(1)}
5%	195	211	287	231 ^{ab}
10%	200	177	217	197 ^{bc}
15%	169	161	197	176 ^c
20%	155	165	147	156 ^c
X for effect of ground skin	194	195	222	X 203

1. Means of any column or row with the same letter are not significantly different at the 1% level of probability as judged by Duncan's New Multiple Range Test.

2. Observations/treatment = 3.

SUMMARY AND CONCLUSION

The increasing addition of TVP and skin into cooked turkey rolls resulted in significantly decreasing shear values, for the product. Lower Hunter Color "L" values were evident as the amount of TVP and skin was increased, but this darkening of the product was deemed to be not objectionable. Higher Hunter "a" values resulted from the incorporation of increased amounts of TVP into the product. Increased Hunter "b" values, or more yellowness, became evident as the amount of TVP and skin was increased. As the amount of skin and TVP was increased the moisture content of the product decreased. It was determined that cooking losses may be significantly reduced through the use of TVP.

Color as determined by a sensory panel was acceptable regardless of the amounts of skin and TVP present. Increasing amounts of skin and TVP resulted in lower sensory odor scores, but all odor scores were acceptable. Sensory flavor scores compared favorably with earlier reported work, but the amount of TVP and skin was increased flavor scores decreased. Sensory texture scores were affected only by the amount of TVP present, and all scores for texture were acceptable regardless of the amount of TVP. Appearance scores were reduced as the amount of skin and TVP was increased, but all treatments remained intact with no internal voids present.

Cooked, boneless, turkey rolls may be manufactured containing ground skin up to 12%, and textured vegetable protein, up to 20%, with no appreciable loss in acceptability or quality.

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