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Effect of Tapioca Flour on Physicochemical Quality Measurements and Sensory Attributes of Low Fat Chicken Breast Patties

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Introduction

- Plant starches have been traditionally used as a binder and fat replacer to increase palatability in ground meat.
- Common plant starches in the application include tapioca, corn, rice , garbanzo, and potatoes.
- Experiments and cooking practices have shown that tapioca starch positively affect textural quality as well as flavor quality in buffalo and pork sausages.
- There is a lack of published information on effect of tapioca on ground poultry meat.

Objectives

1. To evaluate the effect of tapioca flour on flavor, texture and physicochemical characteristics of low fat chicken breast meat patties.
2. To compare the quality effect of tapioca flour to different binders on ground chicken breast meat

Materials and Methods

- **Experimental design**
  - Experiment 1 – Quality effects of 4 different concentrations of tapioca flour (0%, 1%, 2% and 4%)
  - Experiment 2 – Comparison of 2% of tapioca four with 2% different binders, potato flour, garbanzo flour, and egg white
- **Materials and methods**
  - ***Broiler breast meat (pectoralis major):*** Collected from a local commercial processing plan (2 hrs postmortem), minced using meat grinder Mega force 3000 series TM air induction air cooled meat grinder) with a medium plate (1.25" hole) and mixed with or without binders to make patties.
  - ***pH measurement***: Taken on the minced meat using a Hanna Instruments 99163N portable pH/temperature meter with a spear tipped probe.
  - ***Color measurements:*** Conducted with a Minolta spectrophotometer CM-700d (Konica Minolta, Ramsey NJ) on the surface of broiler breast meat before mincing.
  - ***Cooking***: Carried out in combi oven to endpoint temperature 78-80˚C.
  - ***Shear force:*** Determined with Allo Kramer method (5-blade AK ,50 kg load cell at a test speed of 5 mm/sec)
  - ***Sensory evaluation:*** Conducted by 8 trained panelists using Spectrum method with 10 attributes sweet, salty, meaty, sour, brothy, hardness, cohesiveness, juiciness, grittiness and chewiness and a 15-point scale. Each sample were cut into 8 wedges and served in soufflé cups.
  - ***Data analysis***: Carried out using Xl-STAT, ANOVA procedure for physicochemical property measurements and SAS GLM model for sensory evaluation results with Tukey's method for mean separation ($p < 0.05$).

Results and Discussion

Table 1 . Effect of tapioca on pH, cook loss , and shear force of chicken breast meat patties

Treatment (% tapioca)	pH	Cook Loss	Shear Force
0	6.1^{a} ±0.1	26.2^{a} ±4.6	27.0^{a} ±2.1
1	6.0^{a} ±0.1	19.2^{b} ±2.9	13.3^{b} ±1.5
2	5.9^{b} ±0.1	13.3^{c} ±1.3	11.2^{b} ±1.1
4	5.9^{b} ± 0.1	4.6^{d} ±1.2	10.5^{b} ±7.5

Table 2: Mean comparisons of sensory attributes of cooked chicken breast meat patties with different concentrations of tapioca (mean±std, n=32).

Treatment	Attribute									
	Sweet	Salty	Sour	Brothy	Meaty	Cohesiveness	Hardness	Juiciness	Gritty	Chewiness
0% Tapioca	0.5 ±0.4	2.7 ±0.7	0.4 ±0.3	3.4 ±2.6	2.4 ±1.4	5.4^{a} ±1.7	5.8^{a} ±1.1	2.4 ±1.6	3.3 ±3.0	4.3^{a} ±1.9
1% Tapioca	0.6 ±0.5	2.4 ±0.8	0.4 ±0.5	3.3 ±2.9	1.9 ±1.4	3.0^{b} ±1.4	3.8^{b} ±1.5	3.2 ±2.3	3.3 ±2.3	3.3^{ab} ±1.4
2% Tapioca	0.5 ±04	2.7 ±1.3	0.3 ±0.3	3.3 ±2.9	2.0 ±1.3	3.0^{b} ±1.4	3.8^{b} ±1.5	3.2 ±2.2	3.3 ±2.3	3.3^{b} ±1.2
4% Tapioca	0.6 ±0.7	2.7 ±1.0	0.4 ±0.3	3.0 ±2.9	2.0 ±1.3	2.9^{b} ±1.6	3.7^{b} ±1.4	2.8 ±2.0	3.0 ±2.6	3.3^{ab} ±2.0

Assessment of physicochemical properties and mean comparisons of sensory attributes in chicken patties with different concentrations of tapioca

- There were significant statistical differences in cook loss between control and tapioca patties (patties with tapioca) and increased tapioca content resulted in significantly decreased cook loss.
- There were significant differences in shear force between control and tapioca patties regardless of tapioca concentration, and no differences between the three different tapioca patties.
- There were no significant differences between control and tapioca patties for sensory attributes sweet, salt, sour, brothy, meaty, juiciness, gritty. However, there were significant differences between control and tapioca patties regardless of tapioca concentration for sensory attributes cohesiveness and hardness. There was a significant difference between control and 2% tapioca patties for sensory attribute chewiness.
- There were no differences between the three different tapioca patties regardless of sensory attribute.

Table 3 . Cook loss , pH, and shear force of cooked chicken patties with different binders

Treatments	pH	Cook Loss	Shear Force
Control (0% binder)	6.0^{a} ±0.1	23.0^{a} ±3.3	21.6^{a} ±4.5
Garbanzo Flour (2%)	6.0^{a} ±0.1	18.7^{b} ± 4.2	22.3^{a} ±4.0
Tapioca Flour (2%)	5.9^{a} ±0.1	13.0^{c} ±3.0	13.2^{a} ±2.1
Egg White (2%)	5.9^{a} ±0.3	18.1^{b} ±4.9	23.7^{b} ±4.2
Potato Flour (2%)	6.0^{b} ±0.1	19.6^{b} ± 2.7	13.5^{b} ±4.2

Table 3: Mean comparisons of sensory attributes of cooked chicken patties with different binders (mean±std, n=40).

Attribute	Binder				
	Control (no binder)	Tapioca Starch (2%)	Garbanzo Flour (2%)	Potato Flour (2%)	Egg White (2%)
Sweet	0.6 ±0.5	0.5 ±0.3	0.5 ±0.4	0.6 ±0.5	0.9 ±1.1
Salty	2.7 ±0.9	2.7 ±1.0	2.7 ±0.8	2.5 ±0.6	3.0 ±1.4
Sour	0.4 ±0.5	0.5 ±0.6	0.6 ±1.0	0.6 ±1.2	0.4 ±0.8
Brothy	3.0 ±2.1	2.7 ±2.3	2.8 ±2.1	2.7 ±2.7	3.0 ±2.3
Meaty	2.0^{b} ±1.2	2.0^{b} ±1.2	2.1^{ab} ±1.1	2.1^{ab} ±1.3	3.0^{a} ±1.8
Cohesiveness	4.7^{ab} ±1.8	4.0^{b} ±1.7	3.7^{b} ±1.4	4.1^{ab} ±1.7	5.4^{a} ±1.5
Hardness	5.4^{ab} ±1.0	4.3^{c} ±1.5	4.6^{bc} ±1.0	4.7^{bc} ±0.8	5.6^{a} ±0.8
Juiciness	2.2 ±1.5	2.5 ±1.6	2.4 ±1.6	2.7 ±1.6	2.3 ±1.5
Gritty	3.3 ±2.7	3.5 ±2.5	3.4 ±2.6	3.5 ±2.2	3.3 ±2.4
Chewiness	3.6 ±1.5	3.6 ±1.7	3.2 ±1.1	3.8 ±1.4	4.1 ±1.4

Assessment of physicochemical properties and mean comparisons of sensory attributes in chicken patties with different binders

- There were significant statistical differences in cook loss and shear force between cooked chicken breast meat patties with different binders.
- Cook loss of patties with a binder was significantly lower than control (without a binder). Cook loss of tapioca patties was significantly lower than all the other patties with different binders.
- There were no significant differences between cooked control, garbanzo, and egg white patties for shear force. However, shear force of cooked tapioca and potato patties, which were not different from each other, were significant lower than control, garbanzo, and egg white patties.
- There were no significant differences between different 5 treatments for sensory attributes sweet, salty, sour, brothy, juiciness, gritty, and chewiness.
- There were significant differences in meaty, cohesiveness and hardness in cooked chicken patties with different binders.
- Average intensity score of egg white patties for attribute meaty was significantly higher than those of control and tapioca patties. There were no differences between control, tapioca, garbanzo, and potato patties and also no differences between egg white, garbanzo and potato patties.
- Average intensity score of egg white patties for attribute cohesiveness was significantly higher than those of tapioca and garbanzo patties. There were no differences between control, tapioca, garbanzo, and potato patties and between egg white, control, and potato patties.
- Average intensity score of egg white patties for attribute hardness was significantly higher than those of tapioca, garbanzo, and potato patties. The intensity score of control patties was also significantly higher than that of tapioca patties.

Conclusion

- **Tapioca as low as 1% can significantly improve cook loss, shear force, and sensory attributes cohesiveness and hardness, indicating that adding tapioca to chicken breast patties enhances both physicochemical properties and sensory texture quality.**
- **Compared with binders egg white, garbanzo, and potato, tapioca performs either equally or better in improvements in physicochemical properties and sensory quality of chicken breast patties.**