

Full Length Research Paper

## Utilization of common carp fish surimi in baby food products

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This work was conducted to increase the nutritional value of some baby food namely Cerelac (rice-base) widely distributed in the Egyptian markets. Raising protein and minerals of baby food (Cerelac) increases its nutritional value. Dried surimi from common carp fish (*Cyprinus carpio*) fortified at 10, 20 and 30% levels. Chemical composition, microbiological, quality aspects and sensory evaluation were determined. Results indicated that moisture; protein, fat, ash, carbohydrates and energy values of surimi were 12.71, 60.77, 0.35, 4.29 and 21.88%, 333.75 kcal/100 g w/w, respectively. Aerobic bacterial counts detected *Staph. spp.*, Coliform group, *Salmonella* and *Shigella*, while anaerobic bacteria and mold and yeasts did not detect. Increasing levels of surimi result an increment of moisture, protein, and ash contents. Fat, fiber and carbohydrates contents were reduced. Grams daily requirement (GDR) and percent satisfaction (PS/150) for protein decreased, while GDR and PS/150 for energy value increased. Fortification with 30% dried surimi leads to a maximum improvement of all tested sensory evaluation by different rates. This work strongly recommend that the fortification of Cerelac with 30% dried common carp fish surimi due to a maximum improvement of all tested sensory evaluation and nutritional value by different rates.

**Key words:** Surimi, fortification, Cerelac, nutritional value.

### INTRODUCTION

The important sections of less developed countries of the world are believed to be facing problem of malnutrition due to deficiencies in protein. Fish protein has been proposed as a possible solution to this problem. Meat and fish protein provide approximately one-third of the dietary protein requirements (Buffa, 1971). With the decrease in the availability of traditional caught fisheries products, the demand for other sources of protein

appears to be growing.

Carp fish is considered the main type of fish widely produced in fish farms all over the world. Their advantages are likely due to faster of their growth and easy to breed. Common carp fish is unacceptable to the consumer in the fresh form due to numerous species penetrating the flesh. However, ready to eat products (processed fish) were developed in an attempt to

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increase the acceptability and utilization of carp fish (Ganesh et al., 2006).

Surimi is a Japanese term for mechanically deboned fish flesh that has been washed with water and mixed with cryoprotectants for good frozen shelf-life (Toyoda et al., 1992). It is used as an intermediate product for a variety of seafood derivatives (Park et al., 2005), such as the crab legs and flakes. Minced fish, on the other hand, is a mechanically separated flesh that has not been washed and does not have good freeze storability. Washing not only removes fat and undesirable materials, such as blood, pigments and odor substances, but more importantly, increases the concentration of myofibrillar protein (actomyosin), thereby improving gel strength and elasticity, being the essential functional properties for surimi-based products (Guenneugues and Morrissey, 2005).

Surimi is made from minced meat, providing opportunities to use different sources of protein in its production, such as underutilized species with little or no commercial value, including non-fish species. The surimi process, parts of it or modified versions, could be a way of exploiting resources that otherwise would be neglected by the food industry and consumers. Fortunately, the use of novel species for the production of surimi is increasing. Besides fish, the potential for other resources, such as cephalopods (Cortés-Ruiz et al., 2008) and giant squid (Campo-Deaño et al., 2009). In addition, crabs are being studied for surimi production with the incorporation of new methods and technologies according to Luo et al. (2004).

Surimi has a high protein (14%) and low fat content (0.21%) as determined by proximate chemical analysis. The addition of surimi to food systems has been suggested as a way of improving of myofibrillar proteins to polymerize and entrap water in a network structure (Lanier, 1984).

Abd El-Aal and Ibrahim (2001) reported that minced fillet of silver carp fish had 78.97% moisture, 18.39% protein, 0.42% fat and 1.15% ash, while surimi had 79.39% moisture, 11.68% protein, 0.28% fat and 0.55% ash. Garcia et al. (1993) found that boar surimi-like material tended to have lower microbial counts and less lipid oxidation than unwashed counterparts.

As for fish meat, it is characterized by its high nutritional value due to its content of protein, minerals and vitamins. It is also easy to be digested and its aroma is attracting for consumer. Yet, the catfish and carp fish have fewer acceptances because of its low eating qualities and toughness, in addition the catfish was dark colored muscles and carp fish was more spines (fishbone) between flesh. Accordingly, in present study, it is suggested that minced meat of catfish and carp fish may be used to produce an intermediate raw material (surimi) which is characterized by its high nutritional value. This raw material should have good functional properties and may be used to improve the nutritional value of variety of food products. Surimi has a white color and no fish odor.

It can also be added to baby foods as a supplement to raise the nutritional value according to Luo et al. (2004).

Hence, the objective of this work is to increase the nutritional value of some baby food namely Cerelac (rice-base) using dried surimi from common carp fish (*Cyprinus carpio*) fortified with 10, 20 and 30% levels.

## MATERIALS AND METHODS

### Source of materials

Male and female common carp fish (*C. carpio*) was purchased from the local wholesale market at Cairo City, Cairo Governorate. Samples were put into an ice box and transported to the laboratory for Faculty of Home Economics, Minufiya University.

Baby food (Cerelac) was purchased from a pharmacy at Sheben El-Kom City, Minufiya Governorate. Sugar (sucrose) was obtained from the local market at Sheben El-Kom City, Minufiya Governorate. Sorbitol and sodium tripolyphosphate (STPP) were purchased from El-Gomhoria Co., Cairo, Egypt. This work has been carried out in Minufiya University, Egypt starting at April, 2010.

### Preparation of fish samples

Common carp fishes (about 5 kg of each) were washed, packed in polyethylene bags and stored at -20°C for 2 weeks until used. After thawing (overnight at 4°C.) the fish were eviscerated, headed, skinned, cleaned, washed and filleted by hand. The fillets without skin were ground using a meat grinder (Moulinex, HV2, Model A14, Moulinex, France) with 4 mm whole plate.

### Preparation of surimi from common carp fish

Surimi was prepared from fillets using the methods described by Park et al. (1990) with some modification. The minced fish meats were immediately washed three times in stainless steel container (25 L) with water 1 part and crushed ice. 2 parts (iced water) at a ratio of 1 part minced fish to 3 parts iced water (W:W). Hand whipped was used to stir slurry 5 min, and excess water was removed between washing using cheese cloth. After the final washing cycle the minced fish was put in a cheese cloth bag and water removed by compression. Raw surimi was either directly packaged or mixed with cryoprotectants (4% sucrose, 4% sorbitol and 0.25% STPP) and chopped for 2 min using a meat blender (Moulinex, HV2, Model A14, Moulinex, France) and then packaged in polyethylene bags and stored at -4°C until analysis.

### Dried surimi production

Frozen surimi from carp fish was thawed over night at 5°C in a refrigerator. Samples distributed in pan and put in vacuum oven to dry for 35 min at 55°C to obtain dried surimi, samples were weighted (dried weight). Preliminary dehydration trails were conducted to determine the most suitable time and temperature for the treatment.

### Supplementation of baby foods (Cerelac)

Dried carp fish meat surimi was crushed to obtain homogenized dried surimi (surimi supplement) and added to Cerelac supplemented at 10, 20 and 30% to obtain supplemented formulas (W.W.). These supplemented formulas with dry surimi were

**Table 1.** Chemical composition of dried surimi from common carp fish.

| Chemical composition (%)     | Fish                          |                |
|------------------------------|-------------------------------|----------------|
|                              | Dried common carp fish surimi |                |
|                              | WW (g)                        | DW (g)         |
| Moisture (%)                 | 12.71 ± 0.00115               | -              |
| Protein (%)                  | 60.77 ± 0.00107               | 69.62 ± 0.0022 |
| Fat (%)                      | 0.35 ± 0.15744                | 0.40 ± 0.0206  |
| Ash (%)                      | 4.29 ± 0.00056                | 4.91 ± 0.0021  |
| Carbohydrates (glycogen) (%) | 21.88 ± 0.00156               | 25.07 ± 0.0017 |
| Energy value (K.cal/100 g)   | 333.75 ± 0.00012              | -              |

WW, Wet weight; DW, dry weight.

analyzed for chemical and microbiological characteristics. Preliminary supplement baby foods (Cerelac-rice base) with dried surimi were evaluated to determine the suitable treatment required for these baby foods.

#### Analytical methods

Moisture, protein (N × 6.25 Keldahl method), fat (hexane solvent, Soxhiet apparatus), fiber and ash were determined according to the method recommended by AOAC (2003).

#### Carbohydrates (as glycogen) and energy value

Carbohydrate was calculated by differences as follows:

% Carbohydrates = 100 - (% moisture + % protein + % fat + % fiber + % ash).

Energy value was estimated by multiplying protein and carbohydrates by 4.0 and fat by 9.0 (AOAC, 1995).

#### Microbiological methods

##### Preparation of fish samples and supplemented baby food samples for microbiological investigation

Total aerobic plate count (TAPC) determined on nutrient agar media according to the method described by Oxide Manual (1979), *Staphylococcus aureus* determined on Paired parker agar base media (ICMSF, 1996), while molds and yeast, enumerated in potato dextrose agar (ICMSF, 1996), Coliform bacterial (Oxoid) enumerated on Endo agar media (WHO, 1988), *salmonella* sp. and *Shigella* SS agar modified Oxoid according to Bryan (1991) and anaerobic bacteria was examined using nutrient agar media (Difco Manual, 1970).

#### Organoleptic evaluation

Baby foods (Cerelac) supplemented were subjected to organoleptic tests (by 10 judges) according to Watts et al. (1989). Judging scale for color, aroma, taste, texture and overall acceptability was as follows: Very good 8 - 9, Good 6 - 7, Fair 4 - 5, Poor 2 - 3 and Very poor 0 - 1.

#### Statistical analysis

Statistical analysis were performed by using computer program statistical package for social science (SPSS), and compared with each other using the suitable tests. All obtained results were tabulated. Significant differences between treatments means were determined using Duncan's multiple test (1955).

## RESULTS AND DISCUSSION

### Chemical composition of dried surimi from common carp fish

The chemical composition of dried surimi from common carp fish is shown in Table 1. On the other hand, the energy value of dried surimi from common carp fish was 333.75 kcal/100 g on wet weight basis. These results are in agreement with Abd El-Aal and Latif (2002) and Ibrahim et al. (2005).

### Microbiological aspects of dried surimi from catfish and common carp fish

Data presented in Table 2 show the microbiological aspects of dried surimi from common carp fish. The results showed that the TAPC was the only detected microorganisms in dried surimi from common carp fish. The Value was  $1.7 \times 10^1$  cfu/g. On the other hand, *Staphylococcus* spp., Coliform group, *Salmonella* and *Shigella*, anaerobic bacteria and mold and yeasts were not detected in dried surimi of common carp fish. Results from the same table revealed that drying process had tremendous effect on the number of microorganisms. This observation may be due to the flow chart of processing of dried surimi on the microorganisms by destroying their tissues. Niki et al. (1982) published the results microbial tests of spray dried surimi made from Alaska Pollock which were as follows: bacterial count  $1 \times 10^4$  cfu/g, Coli-aerogenes group not detected, Psychrotrophic bacteria  $8 \times 10^3$  cfu /g, *Salmonella* not detected, Yeasts 30 cfu /g, Mold 20 cfu/g and *Vbrio*

**Table 2.** Microbiological aspects of dried surimi from common carp fish (cfu/g).

| Test of microorganisms                | Dried common carp fish surimi |
|---------------------------------------|-------------------------------|
| Total aerobic plate count (TAPC)      | $1.7 \times 10^1$             |
| <i>Staphylococcus</i> spp.            | N.D.                          |
| Coliform group                        | N.D.                          |
| <i>Salmonella</i> and <i>Shigella</i> | N.D.                          |
| Anaerobic bacteria                    | N.D.                          |
| Mold and yeast                        | N.D.                          |

**Table 3.** Chemical composition of baby food (Cerelac).

| Chemical composition (%)   |    | Cerelac of baby food |
|----------------------------|----|----------------------|
| Moisture                   | WW | 2.92                 |
|                            | DW | -                    |
| Protein                    | WW | 7.10                 |
|                            | DW | 7.32                 |
| Fat                        | WW | 1.70                 |
|                            | DW | 1.75                 |
| Ash                        | WW | 1.66                 |
|                            | DW | 1.71                 |
| Fiber                      | WW | 2.10                 |
|                            | DW | 2.16                 |
| Carbohydrates (glycogen)   | WW | 84.49                |
|                            | DW | 87.06                |
| Energy value (k.cal/100 g) | WW | 381.66               |
|                            | DW | -                    |

WW, Wet weight; DW, dry weight.

*paratheempolyticus* not detected.

### Chemical composition of baby food (Cerelac)

Data given in Table 3 shows the chemical composition of baby food (Cerelac), these results are close to that reported by Egyptian Organization for Standardization and Quality Control (1990) which noted that the chemical composition's standard for weaning food mixture are as follows: moisture % not increases than 7% and ash not increases than 3%; but protein (7.10) was less than mentioned reference, being not less than 15%. Data of Table 3 for Cerelac, however similar to that reported by Sidky (1995). These results are in agreement with that reported by Bowes and Church (1983) and Thomokinson and Mathur (1985).

### Chemical composition of baby food (Cerelac) as influenced by addition different levels of dried common carp fish surimi

The chemical composition of baby food (Cerelac) as influenced by addition different levels of dried common carp fish surimi is shown in Table 4. The obtained results indicated that the increasing fortification levels of dried common carp fish surimi in baby food (Cerelac) resulting a markedly increase of moisture content (%). In case of protein and ash contents (%), it could be noted that increasing the fortification levels of baby food (Cerelac) with dried common carp fish surimi result a significant increase in protein and ash contents. On the other hand, fat, fiber and carbohydrates content (%) showed a markedly reduction with increasing fortification levels by dried common fish surimi. Also, energy value recorded a

**Table 4.** Chemical composition of baby food (Cerelac) as influenced by addition different levels of dried common carp fish surimi.

| Sample                                 |    | Chemical composition (%) |         |      |      |       |               | Energy value (kcal/100 g) |
|--|----|--------------------------|---------|------|------|-------|---------------|---------------------------|
|  |    | Moisture                 | Protein | Fat  | Ash  | Fiber | Carbohydrates |                           |
| Control (0%)                           | WW | 2.95                     | 7.10    | 1.70 | 1.66 | 2.10  | 84.49         | 381.66                    |
|  | DW | -                        | 7.32    | 1.75 | 1.71 | 2.16  | 87.06         | -                         |
| With 10% dried common carp fish surimi | WW | 4.85                     | 11.50   | 1.59 | 1.90 | 1.79  | 78.37         | 373.79                    |
|  | DW | -                        | 12.09   | 1.67 | 2.00 | 1.88  | 82.36         | -                         |
| With 20% dried common carp fish surimi | WW | 5.67                     | 15.52   | 1.45 | 2.17 | 1.58  | 73.61         | 369.57                    |
|  | DW | -                        | 16.45   | 1.54 | 2.30 | 1.68  | 78.03         | -                         |
| With 30% dried common carp fish surimi | WW | 6.10                     | 18.45   | 1.32 | 2.43 | 1.37  | 70.33         | 367.00                    |
|  | DW | -                        | 19.65   | 1.45 | 2.59 | 1.46  | 74.90         | -                         |

WW, Wet weight basis; DW. dry weight basis.

**Table 5.** Nutritional evaluation of baby food (Cerelac) as influenced by addition different levels of dried common carp fish surimi.

| Sample                                 | Protein |          | Total calories |         |
|--|---------|----------|----------------|---------|
|  | GDR (g) | PS /150% | GDR (g)        | PS/150% |
| Control (0%)                           | 197     | 25       | 223            | 22.45   |
| With 10% dried common carp fish surimi | 122     | 41       | 227            | 21.99   |
| With 20% dried common carp fish surimi | 90      | 55       | 230            | 21.24   |
| With 30% dried common carp fish surimi | 76      | 66       | 232            | 21.59   |

markedly reduction with increasing dried common carp fish surimi. These results are in agreement with the findings of Saad (2006).

#### Nutritional evaluation of baby food (Cerelac) for infant as influenced by addition different levels of dried common carp fish surimi.

Data given in Table 5 show the nutritional evaluation of baby food (Cerelac) for infant (6-12 months of age) as influenced by addition different levels of dried common carp fish surimi. It is clear to notice that grams daily requirement (GDR) is for protein decreased, while GDR for energy value increased with increasing fortification levels of dried common carp fish surimi in baby food (Cerelac).

On the other hand, PS/150 for protein increased, while PS/150 for energy value decreased with increasing fortification levels by dried common carp fish surimi in baby food (Cerelac).

#### Sensory evaluation of baby food (Cerelac) as influenced by addition different levels of dried common carp fish surimi

Data presented in Table 6 show the sensory evaluation of

baby food (Cerelac) as influenced by addition different levels of dried common carp fish surimi. It is clear to mentioned that the scores of all tested sensory evaluation (color, aroma, taste, texture and overall acceptability) of control baby food (0% dried common carp fish surimi). There is fortification of baby food (Cerelac) with 20% dried common carp fish surimi due to a markedly improvement of all tested sensory evaluation by different rates. On the other hand, the maximum sensory evaluation of baby food was recorded with 30% dried common carp fish surimi. .

#### Conclusions

In the current study, the TAPC was the only detected microorganisms in dried surimi from common carp fish. On the other hand, *Staphylococcus* spp., Coliform group, *Salmonella* and *Shigella*, anaerobic bacteria and mold and yeasts were not detected. The results also showed the increasing fortification levels of dried common carp fish surimi in (Cerelac) resulting a markedly increase of moisture, protein, ash contents (%), while fat, fiber and carbohydrates content (%) showed a markedly reduction with increasing fortification levels by dried common fish surimi. GDR for protein decreased; GDR for energy value increased with increasing fortification levels in (Cerelac).

**Table 6.** Sensory evaluation of baby food (Cerelac) as influenced by addition different levels of dried common carp fish surimi.

| Panel test            | Type of formulas |  |  |  |
|-----------------------|------------------|--|--|--|
|                       | Control (0%)     | With 10% dried common carp fish surimi | With 20% dried common carp fish surimi | With 30% dried common carp fish surimi |
| Colour                | 7 <sup>a</sup>   | 8 <sup>ab</sup>                        | 9 <sup>b</sup>                         | 9 <sup>b</sup>                         |
| Aroma                 | 6 <sup>a</sup>   | 7 <sup>ab</sup>                        | 8 <sup>bc</sup>                        | 9 <sup>c</sup>                         |
| Taste                 | 7 <sup>a</sup>   | 8 <sup>ab</sup>                        | 9 <sup>b</sup>                         | 9 <sup>b</sup>                         |
| Texture               | 9 <sup>a</sup>   | 8 <sup>a</sup>                         | 8 <sup>a</sup>                         | 8 <sup>a</sup>                         |
| Overall acceptability | 7 <sup>a</sup>   | 8 <sup>ab</sup>                        | 9 <sup>b</sup>                         | 9 <sup>b</sup>                         |

Mean under the same line bearing different superscript letters are different significantly (  $p < 0.05$ ).

On the other hand, PS/150 for protein increased, while PS/150 for energy value decreased with increasing fortification levels in Cerelac. This work strongly recommend the fortification of Cerelac with 30% dried common carp fish surimi due to a maximum improvement of all tested sensory evaluation and nutritional value by different rates.

### Conflict of Interests

The authors have not declared any conflict of interests.

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