Global Journal of Biology and Life Sciences | ***ISSN 1694-4429***
Published by ACADEMIC INK REVIEW | *https://airjournal.org/mphrj*
16/18 Avenue des Longaniers, Quatre Bornes, Mauritius
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Impact of Monosodium Glutamate (MSG) and Soya Bean Administration on Cancer Marker Levels in Rats: A Comparative Study

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Abstract

This study investigates the impact of monosodium glutamate (MSG) and soya bean consumption on cancer markers in rats, employing a rigorous methodology involving various laboratory equipment and chemicals. A comprehensive analysis of cancer markers was conducted using state-of-the-art instrumentation. The determination of pancreatic cancer markers (CA 19-9) involved employing a CA 19-9 ELISA kit. Serum samples were processed according to the manufacturer's instructions. Relative Light Units for each sample were measured, and CA 19-9 concentrations were calculated in ng/ml. Colorectal cancer markers (CEA) were assessed using a CEA ELISA kit. Serum samples were processed similarly, and CEA concentrations were expressed in ng/ml. Additionally, ovarian cancer markers (CA-125) were examined using a CA-125 ELISA kit, with concentrations estimated in ng/ml. Statistical analyses were performed using one-way ANOVA, and data were reported as Mean ± Standard Deviation (S.D). The study utilized Statistical Package for Social Sciences (SPSS) version 20, with a confidence interval of 95% ($p < 0.05$). The findings elucidate significant alterations in cancer markers due to MSG and soya bean consumption, providing valuable insights into the potential health risks associated with these dietary components. This study contributes valuable data to the field, emphasizing the importance of understanding the intricate relationship between dietary elements and cancer markers, thereby paving the way for informed dietary choices and targeted preventive strategies.

Keywords	Cancer Markers; Monosodium Glutamate (MSG); Soya Bean Consumption; ELISA Analysis
Citation	Bob Chile-Agada, A. (2022). Impact of Monosodium Glutamate (MSG) and Soya Bean Administration on Cancer Marker Levels in Rats: A Comparative Study. *Global Journal of Biology and Life Sciences, 4(2) 1-10* https://doi.org/10.5281/zenodo.10369203

Background

Cancer, a complex and multifaceted disease, continues to pose a significant global health challenge, with its prevalence steadily increasing across populations. Numerous factors, including genetic predisposition (Mbemi et al., 2020; and environmental influences (Lewandowska et al., 2019), contribute to the development of cancer. In recent years, dietary habits and food additives have emerged as potential factors influencing cancer risk (Ksouri, 2019). Among these dietary components, monosodium glutamate (MSG) and soya bean, commonly found in various food products, have attracted attention due to their widespread consumption. While MSG, a flavor enhancer, is prevalent in processed foods, soya bean and its derivatives are integral parts of many diets worldwide, especially in vegetarian and vegan lifestyles.

The relationship between dietary components and cancer has been a subject of extensive research, and several studies have explored the impact of specific food additives and plant-based compounds on cancer development. Understanding the effects of MSG and soya bean consumption on cancer markers is crucial, as it can provide valuable insights into potential health risks associated with these dietary choices.

However, despite the growing interest in the association between diet and cancer, there is limited research investigating the specific influence of MSG and soya bean on cancer markers. To address this gap in knowledge, this study aims to comprehensively examine the activities of cancer markers in rats administered monosodium glutamate and soya bean. By analyzing colorectal, pancreatic, ovarian, and prostate cancer markers in both female and male rats, this research seeks to elucidate the potential correlations between the duration and dosage of MSG and soya bean administration and cancer marker alterations.

This research is pivotal in advancing the understanding of the impact of MSG and soya bean on cancer markers, shedding light on the underlying mechanisms that may contribute to cancer development. The findings from this study have the potential to inform dietary guidelines and raise awareness about the risks associated with certain food additives and plant-based components. Ultimately, this research can contribute to the development of preventive strategies and public health interventions aimed at reducing cancer incidence and improving overall health outcomes.

Research Objectives

Objective 1: To investigate the effects of different doses and durations of Monosodium Glutamate (MSG) and Soya Bean administration on colorectal, pancreatic, ovarian, and prostate cancer markers in female and male rats.

Objective 2: To compare the changes in cancer marker levels among rats administered with various doses and durations of MSG and Soya Bean, and analyze the potential correlations between specific markers and the duration and dosage of administration, shedding light on the potential carcinogenic impact of these substances.

This research aims to provide valuable insights into the relationship between MSG and Soya Bean consumption and the alteration of cancer markers in rats, contributing to a better understanding of the potential risks associated with these dietary components in the development of cancer.

Literature

Cancer Markers in Various Types of Cancer: An Overview

Cancer markers are substances, often proteins or other molecules, found in the blood, urine, or tissues that can indicate the presence of cancer. These markers have become valuable tools in cancer diagnosis, monitoring, and prognosis. This section provides an overview of some key cancer markers in different types of cancer, focusing on prostate-specific antigen (PSA) in prostate cancer, cancer antigen 125 (CA 125) and cancer antigen 19-9 (CA 19-9) in ovarian and pancreatic cancer, and carcinoembryonic antigen (CEA) in colorectal cancer.

Prostate-Specific Antigen (PSA) in Prostate Cancer: Prostate-specific antigen (PSA) is a glycoprotein produced by cells in the prostate gland, both benign and malignant. PSA measurement has become a common diagnostic tool for prostate carcinoma. While a PSA value of 4.0 ng/mL has long been considered the upper limit of normal (Zhu et al., 2005), recent studies have challenged this threshold. PSA levels between 0-4.0 ng/mL have been associated with positive predictive values ranging from 6.6% to 26.9% (Thompson et al., 2004).

Cancer Antigen 125 (CA 125) in Ovarian Cancer: CA 125, a high molecular weight glycoprotein, is a well-known biomarker for ovarian cancer. Elevated CA 125 levels are found in up to ninety percent of individuals with ovarian cancer, making it the gold standard diagnostic marker (Hogdall, 2008). CA 125 is used not only for diagnosis but also to monitor drug responses, differentiate benign from malignant tumors, and assess disease recurrence. While CA 125's sensitivity in screening asymptomatic populations is limited, it remains a crucial tool for managing ovarian cancer patients, especially in monitoring treatment effectiveness (Verheijen et al., 1999).

Cancer Antigen 19-9 (CA 19-9) in Pancreatic Cancer: CA 19-9, also known as sialyl-Lewis^{A}, is a tetrasaccharide attached to cell surface O-glycans, primarily associated with pancreatic cancer management. Studies have shown the limitations of using CA 19-9 as a diagnostic marker, especially in asymptomatic patients, due to low positive predictive values (Kim et al., 2004). However, elevated CA 19-9 levels have been observed in pancreatic cancer patients, and its specificity improves when combined with other diagnostic methods. The diagnostic accuracy of CA 19-9 increases when specific symptoms and imaging techniques are considered alongside elevated CA 19-9 levels (Chang et al., 2006).

Carcinoembryonic Antigen (CEA) in Colorectal Cancer: Carcinoembryonic antigen (CEA) is a glycoprotein antigen used as a marker for colorectal cancer. While it is widely utilized, CEA's diagnostic accuracy is affected by various factors, such as smoking and inflammation, leading to elevated levels in non-cancerous conditions (Tan et al., 2009). CEA's sensitivity and specificity are relatively low, making it less reliable as a standalone marker. When combined with other markers like CA 19-9, CEA's diagnostic accuracy improves, aiding in the prognosis and monitoring of colorectal cancer (Nukata et al., 2012).

In addition to these markers, other emerging biomarkers like circulating tumor DNA and insulin-like growth factor binding protein 2 (IGFBP-2) are being explored for their potential in cancer diagnosis and prognosis. Ongoing research aims to enhance the accuracy of existing markers and identify novel ones, contributing to more precise cancer detection and management strategies.

Materials and Methods

Table 1: Equipment and Sources

Equipment	*Sources*
Automatic Electrolyte Analyzer	Shimadzu UV-160A, Lakewood Carlifonia, USA
BT-3000 auto analyzer	Diamond Diagnostics Inc, Holliston, MA, USA
Centrifuge	Shimadzu UV-160A, Lakewood Carlifonia, USA
Colorimeter	Lovibond™ PFXi-995, Tintometer Limited, Amesbury, UK
Dessicator	East Biopharm, Hangzhou, Zhejiang, China
ELISA plate reader	Omega Bio-Tek Inc. - Norcross, Georgia USA
Gas Chromatography	Agilent Technologies 7890A, Santa Clara, Carlifonia, United States
Glucometer	Roche Diagnostics Indianapolis, IN, United States
Hematology Auto-Analyzer	Mindray,Boulevard, New Jersey, USA
Ichroma Machine	Shimadzu UV-160A, Lakewood Carlifonia, USA
Incubator	Shimadzu UV-160A, Lakewood Carlifonia, USA
Microscope	Shimadzu UV-160A, Lakewood Carlifonia, USA
Oven	Shimadzu UV-160A, Lakewood Carlifonia, USA
pH Meter	Uniscope , SM801A, England
Rotary Evaporator	SHB-520, Korea
Soxhlet Extractor	Uniscope , SM801A, England
Steam Bath	East Biopharm, Hangzhou, Zhejiang, China
Thermometer	East Biopharm, Hangzhou, Zhejiang, China
Water Bath	Biotechnics, Aberdeenshire, Scotland UK
Weighing Balance	South Cross Road Bradford

Table 2: Chemicals/Reagents and Sources

Chemicals/reagents	*Sources*
4-dinitrophenyl hydrazine solution	British Drug House (BDH), England
Acetic acid	Sigma Aldrich St. Louis, MO, USA
Biochemical reagent kits	Randox lab Ltd, Antrim, UK.
Butanol	Sigma Aldrich St. Louis, MO, USA
CA 19-9 ELISA kit	Accubind Elisa Microwells, Monobind Inc. Lakeforest, USA
CA-125 ELISA kit	Accubind Elisa Microwells, Monobind Inc. Lakeforest, USA
Carbonate buffer	British Drug House (BDH), England
CEA ELISA kit	Accubind Elisa Microwells, Monobind Inc. Lakeforest, USA
Dimethylether	Sigma Aldrich St. Louis, MO, USA
Ethanol	British Drug House (BDH), England
Ethylene diamine tetraacetic acid	British Drug House (BDH), England
Follicle Stimulating Hormone test kits	Accubind Elisa Microwells, Monobind Inc. Lakeforest, USA
Glutathione reductase	Qualiken fine chemicals, New Delhi, India
Hexane	Sigma Aldrich St. Louis, MO, USA
Hydrogen peroxide	Sigma Aldrich St. Louis, MO, USA
Insulin kits	Syntron Bioresearch (USA).
Luteinizing Hormone Test kits	Accubind Elisa Microwells, Monobind Inc. Lakeforest, USA
Potassium phosphate buffer	Qualiken fine chemicals, New Delhi, India
Propanol	British Drug House (BDH), England
Randox liver function test kits	140 London Wall, London, England
Randox renal function test kits	140 London Wall, London, England
Sodium azide	Omega Bio-Tek Inc. - Norcross, Georgia USA
Sodium bicarbonate	British Drug House (BDH), England
Sodium hydroxide	British Drug House (BDH), England

Sodium phosphate buffer	Qualiken fine chemicals, New Delhi, India
Sodium sulphate	Sigma Aldrich St. Louis, MO, USA
Sulphuric acid	Sigma Aldrich St. Louis, MO, USA
Testosterone Test kits	Accubind Elisa Microwells, Monobind Inc. Lakeforest, USA
Thiobarbituric acid	Sigma Aldrich St. Louis, MO, USA
Trichloroacetic acid	British Drug House (BDH), England

Determination of Pancreatic Cancer Markers (CA 19-9)

The serum Pancreatic Cancer Markers (CA 19-9) were determined with a CA 19-9 ELISA kit according to the manufacturer's instructions (Accubind Elisa Microwells, Monobind Inc. Lakeforest, USA). Precisely 25µl of the serum reference calibrator was pipetted into an assigned well and 100 µl of the biotinylated labeled antibody was added to each well. Afterwards the microplate was gently swirled for 30secs and incubated at room temperature for 30 mins. Next, the contents of the microplate was decanted by using an adsorbent paper to blot dry, then 350µl of the wash buffer was added and decanted by blot drying four more times. In a similar order of addition of the reagents, 100µl of the Ca 19-9 Tracer reagent was added to all wells, covered and incubated at room temperature for forty five (45) minutes. Next, the contents of the microplate was decanted again by using an adsorbent paper to blot dry, then 350µl of the wash buffer was added and decanted by blot drying five more times. In a similar order of addition of the reagents, 100µl of the working signal reagent was added to all wells, covered and incubated at room temperature for five (5) minutes. The Relative Light Units for each well was thus read, and a plot of the Relative Light Unit for the sample, against the corresponding reference was used to estimate the CA19-9 concentration expressed as ng/ml.

Determination of Colorectal Cancer Markers

The serum colorectal cancer markers (CEA) were determined with a CEA ELISA kit according to the manufacturer's instructions (Accubind Elisa Microwells, Monobind Inc. Lakeforest, USA). Precisely 25µl of the serum reference calibrator was pippeted into an assigned well and 100 µl of the CEA Tracer Reagent was added to each well. Afterwards the microplate was gently swirled for 30secs and incubated at room temperature for 45mins. Next, the contents of the microplate was decanted by using an adsorbent paper to blot dry, then 350µl of the wash buffer was added and decanted by blot drying four more times. In a similar order of addition of the reagents, 100µl of the working signal reagent was added to all wells and incubated for fifteen (5) minutes at room temperature. The Relative Light Units for each well was thus read, and a plot of the Relative Light Unit for the sample, against the corresponding reference was used to estimate the CEA concentration expressed as ng/ml.

Determination of Ovarian Cancer Markers

The serum ovarian cancer markers (CA-125) were determined with a CA-125 ELISA kit according to the manufacturer's instructions (Accubind Elisa Microwells, Monobind Inc. Lakeforest, USA). Precisely 25µl of the serum reference calibrator was pippeted into an assigned well and 100 µl of the CA-125 Tracer Reagent was added to each well. Afterwards the microplate was gently swirled for 30secs and incubated at room temperature for 45mins. Next, the contents of the microplate was decanted by using an adsorbent paper to blot dry, then 350µl of the wash buffer was added and decanted by blot drying four more times. In a similar order of addition of the reagents, 100µl of the working signal reagent was added to all wells and incubated for fifteen (5) minutes at room temperature. The Relative Light Units for each well was thus read, and a plot of the Relative Light Unit for the sample, against the corresponding reference was used to estimate the CA-125 concentration expressed as ng/ml.

Statistical Analysis

All data generated were subjected to statistical analysis. Values were reported as Mean ± Standard deviation (S.D) while one-way ANOVA was used to test for differences among treatment groups using Statistical Package for Social Sciences (SPSS) version 20 at 95% confidence interval ($p < 0.05$).

Results

Activities of Cancer Markers

Table 3 shows the cancer markers of rats administered monosodium glutamate and soya bean. No significant ($p>0.05$) change was observed in the colorectal cancer markers of the female rats administered MSG and soya beans. No significant ($p>0.05$) difference was observed in the colorectal markers of female rats administered soya beans for 4 and 6 months while the MD and HD MSG significantly elevated the CEA levels when administered respectively for 4 and 6 months. No significant ($p<0.05$) change was observed on the levels of pancreatic cancer markers for 2 months soya bean administration while all doses of MSG administered for 2 months significantly ($p<0.05$) increased the CA-19-9 levels (1.10, 1.85, and 1.50 U/ml respectively) relative to the control (0.30 U/ml). Only the administration of MD and HD soya bean for 4 and 6 months, significantly ($p<0.05$) increased the CA-19-9 levels of the female rats, when compared to the control, while all the doses of MSG administered for 4 and 6 months significantly ($p<0.05$) increased the CA-19-9 levels. The result for the ovarian cancer marker (CA-125) showed that only the HD soya bean administered for 2, 4, and 6 months respectively, significantly ($p<0.05$) elevated the CA-125 levels while the MD and HD MSG administered for 4 months and LD, MD and HD MSG administered for 6 months significantly ($p<0.05$) increased the CA-125 levels. For the male rats the administered soya bean doses for 2, 4, and 6 months produced no significant ($p>0.05$) effect on the CEA levels while administration of MD and HD MSG significantly ($p<0.05$) increased the CEA levels. The administration of MD and HD MSG for 2 and 4 months significantly ($p<0.05$) increased the PSA levels while after 6 months, all the doses significantly ($p<0.05$) elevated the PSA concentration when compared to the control level. The PSA levels of rats administered LD and MD soya beans were comparable to the control level while rats administered MD and HD soya bean for 4 and 6 months recorded significantly ($p<0.05$) higher PSA levels when compared to the control.

Table 3: Cancer Markers of Rats administered Monosodium Glutamate and Soya Bean

DURATION	GROUPS	CEA (U/ml)	CEA (U/ml)	CA-19-9 (U/ml)	CA-19-9 (U/ml)	CA-125 (U/ml)	CA-125 (U/ml)
		MSG	SOY	MSG	SOY	MSG	SOY
2 MONTHS				FEMALES			
	C	$0.75\pm0.10^{a*}$	$0.75\pm0.10^{a*}$	$0.30\pm0.02^{a*}$	$0.30\pm0.08^{a*}$	$0.80\pm0.14^{a*}$	$0.80\pm0.14^{a*}$
	LD	$0.70\pm0.17^{a*}$	$0.50\pm0.14^{a**}$	$1.10\pm0.49^{b*}$	$0.25\pm0.07^{a**}$	$0.85\pm0.21^{a*}$	$1.20\pm0.20^{a**}$
	MD	$0.70\pm0.14^{a*}$	$0.45\pm0.17^{a**}$	$1.85\pm0.23^{c*}$	$0.30\pm0.00^{a**}$	$0.75\pm0.21^{ae*}$	$1.10\pm0.14^{a**}$
	HD	$0.75\pm0.11^{a*}$	$0.60\pm0.14^{a*}$	$1.50\pm0.25^{c*}$	$0.25\pm0.07^{a**}$	$0.95\pm0.49^{a*}$	$1.70\pm0.14^{b**}$
4 MONTHS							
	C	$0.85\pm0.07^{a*}$	$0.85\pm0.07^{b*}$	$0.65\pm0.05^{d*}$	$0.65\pm0.35^{b*}$	$0.90\pm0.28^{a*}$	$0.90\pm0.28^{c*}$
	LD	$0.85\pm0.21^{a*}$	$0.85\pm0.07^{b*}$	$1.95\pm0.07^{c*}$	$0.65\pm0.21^{b**}$	$1.05\pm0.21^{a*}$	$0.85\pm0.07^{c**}$
	MD	$1.15\pm0.07^{c*}$	$0.90\pm0.14^{b*}$	$1.85\pm0.20^{c*}$	$1.00\pm0.42^{c**}$	$1.55\pm0.21^{b*}$	$0.85\pm0.07^{c**}$
	HD	$1.60\pm0.14^{de*}$	$0.75\pm0.07^{b**}$	$1.85\pm0.07^{c*}$	$0.90\pm0.14^{c**}$	$1.85\pm0.07^{bc*}$	$1.35\pm0.07^{d**}$
6 MONTHS							
	C	$1.45\pm0.21^{d*}$	$1.45\pm0.21^{c*}$	$0.85\pm0.07^{e*}$	$0.85\pm0.07^{bc*}$	$2.10\pm0.28^{c*}$	$2.10\pm0.28^{e*}$
	LD	$1.95\pm0.21^{ef*}$	$1.30\pm0.42^{c**}$	$1.60\pm0.01^{c*}$	$1.05\pm0.21^{c**}$	$3.80\pm0.14^{d*}$	$2.30\pm0.28^{e**}$
	MD	$2.15\pm0.21^{f*}$	$1.70\pm0.28^{c*}$	$2.45\pm0.03^{f*}$	$1.80\pm0.28^{d**}$	$3.75\pm0.21^{d*}$	$2.50\pm0.28^{e**}$
	HD	$2.60\pm0.28^{g*}$	$1.55\pm0.35^{c**}$	$2.50\pm0.01^{f*}$	$1.90\pm0.28^{d**}$	$4.00\pm0.28^{d*}$	$3.20\pm0.28^{f**}$
				MALES			
2 MONTHS						PSA (ng/ml)	PSA (ng/ml)
	C	$0.75\pm0.07^{ha*}$	$0.75\pm0.07^{d*}$	$0.25\pm0.02^{ga*}$	$0.25\pm0.02^{a*}$	$0.31\pm0.00^{a*}$	$0.31\pm0.00^{ad**}$
	LD	$0.75\pm0.07^{ha*}$	$0.60\pm0.14^{d*}$	$1.55\pm0.03^{hc*}$	$0.28\pm0.05^{a**}$	$0.36\pm0.18^{a*}$	$0.24\pm0.00^{a**}$
	MD	$0.75\pm0.07^{ha*}$	$0.75\pm0.07^{d*}$	$1.75\pm0.07^{hc*}$	$0.30\pm0.07^{a**}$	$0.48\pm0.14^{bd*}$	$0.27\pm0.02^{ac**}$
	HD	$0.70\pm0.14^{ha*}$	$0.75\pm0.21^{d*}$	$1.45\pm0.21^{hjc*}$	$0.25\pm0.04^{a**}$	$0.52\pm0.12^{b*}$	$0.37\pm0.01^{b**}$
4 MONTHS							
	C	$0.95\pm0.21^{iac*}$	$0.95\pm0.21^{e*}$	$0.30\pm0.11^{id*}$	$0.30\pm0.11^{a*}$	$0.23\pm0.01^{c*}$	$0.23\pm0.01^{ad*}$
	LD	$0.80\pm0.14^{ha*}$	$0.90\pm0.00^{e**}$	$1.05\pm0.49^{j*}$	$0.40\pm0.12^{a**}$	$0.20\pm0.01^{c*}$	$0.24\pm0.01^{a*}$
	MD	$1.30\pm0.42^{jcd*}$	$0.85\pm0.21^{e**}$	$1.35\pm0.37^{hj*}$	$0.65\pm0.11^{b**}$	$0.33\pm0.02^{a*}$	$0.30\pm0.02^{ce*}$
	HD	$1.45\pm0.35^{jcd*}$	$1.10\pm0.28^{e**}$	$1.40\pm0.23^{hj*}$	$1.55\pm0.39^{d*}$	$0.44\pm0.03^{d*}$	$0.41\pm0.03^{b*}$
6 MONTHS							
	C	$1.35\pm0.49^{jd*}$	$1.35\pm0.49^{f*}$	0.70±0.01ie*	$0.70\pm0.21^{b*}$	$0.20\pm0.01^{c*}$	$0.20\pm0.01^{d*}$

LD	1.55±0.07^{jd*}	1.25±0.35^{f*}	1.65±0.21^{hc*}	0.80±0.22^{bc**}	0.34±0.00^{a*}	0.34±0.04^{e*}
MD	2.10±0.28^{kf*}	1.45±0.35^{f**}	1.70±0.14^{hc*}	1.00±0.21^{c**}	0.36±0.00^{a*}	0.38±0.05^{b*}
HD	2.40±0.42^{kgf*}	1.75±0.21^{f**}	1.85±0.07^{hc*}	1.20±0.21^{c**}	0.49±0.02^{b*}	0.50±0.02^{f*}

Values are means ± standard deviations n=5. Values with different superscript letter(s) (a-k) down the column or symbols (and **) across the row for each parameter, are significantly different (p < 0.05). MSG - Monosodium glutamate. SOY – Soya bean, CEA – Colorectal cancer marker, CA – 19-9 – Pancreatic cancer marker, PSA – Prostate specific antigen*

Summary of Findings

1. **Colorectal Cancer Markers:**
    a. No significant changes in colorectal cancer markers for female rats administered MSG and soya beans.
    b. Medium (MD) and high doses (HD) of MSG significantly elevated carcinoembryonic antigen (CEA) levels in female rats after 4 and 6 months.
2. **Pancreatic Cancer Markers:**
    a. Significant increase in cancer antigen 19-9 (CA-19-9) levels in rats administered MSG for 2 months.
    b. Prolonged exposure to MD and HD soya bean for 4 and 6 months, as well as MSG for 4 and 6 months, significantly elevated CA-19-9 levels.
3. **Ovarian Cancer Marker:**
    a. High dose (HD) soya bean administration led to significant elevation in cancer antigen 125 (CA-125) levels for 2, 4, and 6 months.
    b. MSG administration, particularly at MD and HD levels, resulted in increased CA-125 levels after 4 and 6 months.
4. **Prostate Cancer Marker:**
    a. MSG administration significantly increased prostate-specific antigen (PSA) levels in male rats, with MD and HD MSG leading to elevated PSA levels after 2 and 4 months, and all doses resulting in increased levels after 6 months.
    b. Soya bean administration did not significantly affect PSA levels at lower doses (LD and MD) but led to significant elevation at MD and HD levels after 4 and 6 months.

Discussion of Findings

The results of the present study provide valuable insights into the effects of monosodium glutamate (MSG) and soya bean administration on various cancer markers in rats. The findings offer a nuanced understanding of the impact of these dietary components on different types of cancer, shedding light on potential associations and risks.

1. Colorectal Cancer Markers: In the context of colorectal cancer markers, the study revealed no significant changes in female rats administered MSG and soya beans. This observation suggests that these substances, at the doses and durations tested, do not significantly influence colorectal cancer markers in female rats. However, it is noteworthy that the administration of medium (MD) and high doses (HD) of MSG significantly elevated carcinoembryonic antigen (CEA) levels when administered for 4 and 6 months. This result raises concerns about the potential impact of MSG on colorectal cancer risk, emphasizing the need for further investigation into the mechanisms behind this elevation in CEA levels.

2. Pancreatic Cancer Markers: The study demonstrated a significant increase in cancer antigen 19-9 (CA-19-9) levels in rats administered MSG for 2 months, indicating a potential link between short-term MSG consumption and pancreatic cancer marker alterations. In contrast, soya bean administration for 2 months did not lead to significant changes in pancreatic cancer markers. However, prolonged exposure to MD and HD soya bean for 4 and 6 months, as well as MSG for 4 and 6 months, significantly elevated CA-19-9 levels. These findings suggest a time-dependent effect, with longer exposure durations leading to more pronounced alterations in pancreatic cancer markers.

3. Ovarian Cancer Marker: The ovarian cancer marker, cancer antigen 125 (CA-125), exhibited significant elevation in rats administered HD soya bean for 2, 4, and 6 months. In contrast, MSG administration, particularly at MD and HD levels, led to increased CA-125 levels after 4 and 6 months. This result highlights the potential influence of both MSG and soya bean on ovarian cancer markers, indicating a need for in-depth studies to explore the underlying mechanisms and the long-term implications of these alterations.

4. Prostate Cancer Marker: In male rats, MSG administration significantly increased prostate-specific antigen (PSA) levels, with MD and HD MSG leading to elevated PSA levels after 2 and 4 months, and all doses resulting in increased levels after 6 months. Interestingly, soya bean administration did not significantly affect PSA levels at lower doses (LD and MD) but led to significant elevation at MD and HD levels after 4 and 6 months. These findings emphasize the potential gender-specific effects of MSG and soya bean on prostate cancer markers and underline the importance of considering sex-related differences in cancer marker responses.

The results of this study highlight the intricate relationship between MSG, soya bean, and cancer markers. The findings underscore the need for further research to elucidate the underlying mechanisms driving these alterations and to assess the long-term consequences of prolonged exposure. Additionally, considering the gender-specific differences observed in prostate cancer markers, future studies should explore hormonal factors and their influence on cancer marker responses. This research contributes valuable data to the field, urging for continued investigation into the impact of dietary components on cancer markers and encouraging informed dietary choices for overall health and cancer prevention.

Implication of Findings

The implications of the findings from this study are significant, as they provide valuable insights into the potential health risks associated with the consumption of monosodium glutamate (MSG) and soya bean. Here are the key implications of the findings:

1. **Colorectal Cancer Risk:**

   The elevation of carcinoembryonic antigen (CEA) levels in female rats following prolonged exposure to medium (MD) and high doses (HD) of MSG raises concerns about the potential link between MSG consumption and colorectal cancer risk. Individuals with a predisposition to colorectal cancer should be cautious about their MSG intake.

2. **Pancreatic Cancer Risk:**

   The increase in cancer antigen 19-9 (CA-19-9) levels after prolonged exposure to both MSG and soya bean suggests a potential risk of pancreatic cancer associated with these dietary components. Further studies are needed to explore the underlying mechanisms and confirm these findings in human populations.

3. **Ovarian Cancer Risk:**

   Elevated cancer antigen 125 (CA-125) levels in response to both MSG and soya bean consumption highlight the need for further research into the impact of these substances on ovarian cancer risk. Women with a family history of ovarian cancer or other risk factors should be aware of their dietary choices.

4. **Prostate Cancer Risk:**

   The significant increase in prostate-specific antigen (PSA) levels in male rats exposed to MSG and soya bean suggests a potential risk of prostate cancer associated with these dietary components. Men, especially those with a family history of prostate cancer, should consider moderating their intake of foods containing MSG and soya bean derivatives.

5. **Gender-Specific Differences:**

   The study underscores the importance of considering gender-specific differences in cancer marker responses. Men and women may exhibit different physiological responses to certain dietary components, emphasizing the need for personalized dietary recommendations based on gender and genetic factors.

6. **Importance of Further Research:**

   The study highlights the complexity of the relationship between dietary components and cancer markers. Further research is essential to unravel the underlying mechanisms and establish definitive links between MSG, soya bean, and cancer risks. Continued investigation can aid in the development of targeted prevention strategies and dietary guidelines.

7. **Public Awareness and Health Policies:**

   The findings emphasize the importance of public awareness regarding the potential health risks associated with MSG and soya bean consumption. Health authorities should consider incorporating these findings into dietary guidelines, raising awareness about the need for moderation and informed dietary choices.

The implications of these findings underscore the necessity of cautious consumption of MSG and soya bean products, especially for individuals with a family history of colorectal, pancreatic, ovarian, or prostate cancer. Public health campaigns and further research efforts are crucial to mitigate potential risks and promote overall health and well-being.

Conclusion

In light of the intricate relationship between dietary components and cancer markers elucidated by this study, it is evident that monosodium glutamate (MSG) and soya bean consumption have significant implications for cancer risk, albeit with nuanced complexities. The findings underscore the critical importance of understanding the impact of these common dietary elements on various cancer types, providing valuable insights into the potential health risks they pose.

The elevation of carcinoembryonic antigen (CEA) levels in female rats exposed to MSG raises concerns about colorectal cancer risk associated with this flavor enhancer. Similarly, the increase in cancer antigen 19-9 (CA-19-9) levels following prolonged exposure to both MSG and soya bean indicates potential risks linked to pancreatic cancer. These findings necessitate further research to unravel the underlying molecular mechanisms and confirm these observations in human populations.

Furthermore, the study sheds light on the gender-specific differences in cancer marker responses. While both male and female rats exhibited altered cancer markers, the patterns of response differed significantly between the sexes. This highlights the importance of considering gender-specific physiological differences in understanding cancer risks associated with dietary choices. Such insights are invaluable for tailoring preventive strategies and dietary recommendations based on individual characteristics.

Importantly, the results emphasize the need for heightened public awareness regarding the potential risks associated with MSG and soya bean consumption. Educating the public about the implications of these dietary components on cancer markers can empower individuals to make informed choices about their diets, thereby

reducing potential health risks. Additionally, these findings should inform healthcare professionals, enabling them to provide targeted advice to patients, especially those with a family history of colorectal, pancreatic, ovarian, or prostate cancer.

In the realm of public health policies, the study's implications are far-reaching. Regulatory bodies and health authorities must consider integrating these findings into dietary guidelines and recommendations. Policies advocating for moderation in MSG and soya bean consumption, especially over prolonged periods, can significantly contribute to reducing cancer risks in populations.

In conclusion, this research advances the understanding of the complex interplay between dietary components and cancer markers. The study's outcomes underscore the importance of continued research to unravel the underlying mechanisms, fostering collaborations between researchers, clinicians, and policymakers. By translating these findings into targeted public health interventions and personalized dietary advice, we can mitigate potential cancer risks, improve overall health outcomes, and ultimately work towards a cancer-free future for all.

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